Essays on horizontal market concentration : accounting for firms' strategies and designing merger control

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ESSAIS SUR LES CONCENTRATIONS HORIZONTALES

STRATÉGIES DES ENTREPRISES ET STRATÉGIES DES AUTORITÉS DE CONCURRENCE

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A mes parents

et à Eric

ESSAYS

ON HORIZONTAL MARKET CONCENTRATION

ACCOUNTING FOR FIRMS' STRATEGIES
AND
DESIGNING MERGER CONTROL

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RÉSUMÉ DE LA THÈSE EN FRANÇAIS

Introduction

Le Financial Times du 30 juin 2006 proposait dans l'article "M&As fever surpasses dotcom era" une estimation saisissante à hauteur de 1930 milliards de dollars pour la valeur globale des fusions et acquisitions à travers le monde pour la première moitié de l'année. Ceci constitue un record absolu, et donne à penser que l'explosion courante de l'activité de concentration pourrait bien dépasser l'épisode similaire du début des années 2000 avec la bulle Internet. Le fait que l'activité de fusions et acquisitions comporte des vagues périodiques est une réalité bien connue – le siècle dernier a pu ainsi voir plusieurs telles épisodes, à la fin des années 20, 60, 80 ou 90. De telles vagues successives de fusions et acquisitions rappellent en fait régulièrement qu'il s'agit d'une pratique généralisée de la part des entreprises[1], avec des conséquences de plus en plus étendues au niveau national et international.

Tout aussi généralisées apparaissent les conclusions portant sur les effets des concentrations. Des études successives (voir Ravenscraft et Scherer (1987), Banerjee et Eckard (1998), ou bien Tichy (2001) pour un résumé d'environ 80 études empiriques) montrent que les transactions profitables ne sont pas les plus fréquentes, au contraire. Ainsi, la

[1] En 2005, The Wall Street Journal du 17 fevrier dans l'article "Bosses Prefer Buying Businesses to Building Them" expliquait en partie l'intense activité de fusions acquisitions par le fait qu'acheter une entreprise est toujours considéré comme plus facile que la créer à partir de zéro.

comparaison internationale réalisée par Gügler et al. (2003) établit que tout au plus la moitié des concentrations augmentent les profits des firmes participantes. De plus, leur étude constate qu'environ la moitié de ces concentrations profitables se solde par des réductions d'output, et par conséquent mène à des hausses des prix, ce qui aboutit à ce que les consommateurs ne profitent au plus que d'un quart des fusions acquisitions qui ont lieu. Gügler et al. (2003) concluent ainsi que si les concentrations qui augmentent le pouvoir de marché des participants, ou bien qui conduisent à une réduction de l'efficacité productive, étaient qualifiées comme néfastes pour le bien-être, alors la majorité des transactions qui ont été réalisées dans le monde depuis environ 15 ans feraient partie de cette catégorie.

Cette conclusion a des implications importantes. D'un point de vue très pratique, les fusions acquisitions peuvent comporter un coût pour les actionnaires en cas de dénouement non profitable, mais aussi pour les consommateurs en cas de hausse du prix ex-post. En termes de recherche économique, il devient donc intéressant d'approfondir l'étude des motivations conduisant à la décision de fusionner, compte tenu du constat de manque de profitabilité. De plus, pouvoir rendre compte des justifications économiques qui sous-tendent les concentrations constitue non seulement un objet d'étude théorique, mais également une étape préliminaire indispensable au contrôle de ces transactions par les autorités de concurrence, qui sont censées protéger la concurrence et les intérêts des consommateurs. En effet, le contrôle des concentrations permet d'identifier les transactions qui soulèvent des problèmes pour le bon déroulement de la concurrence sur les marchés, et/ou qui vont conduire à la baisse du bien-être des consommateurs. Confrontées à l'ampleur et la complexité des fusions acquisitions, les autorités de concurrence doivent constamment adapter leurs instruments et procédures, dans l'espoir de mieux prévenir et contenir les effets négatifs des concentrations.

Néanmoins, des constats empiriques indiquent que cet objectif n'est pas toujours atteint. L'analyse d'une centaine de cas de fusions acquisitions soumises à l'aval de la Commission Européenne en application du Règlement CE sur le contrôle des concentrations a permis à Neven et Röller (2002) de conclure que la Commission Européenne a effectué peu d'erreurs de type I (fusions pro-concurrentielles qui auraient été interdites à tort), mais qu'elle est beaucoup plus assujettie à des erreurs de type II (accépter à tort des fusions

anti-concurrentielles). Duso et al. (2003) ont trouvé en retour des fréquences de 28% et respectivement 23% pour les deux types d'erreur, sur la base d'une étude de 164 décisions prises par la Commission Européenne. Il apparaît donc que le contrôle des concentrations n'est pas toujours efficace, ce qui incite à poursuivre l'analyse des explications possibles de ces erreurs et par conséquent du profile optimal de la politique de la concurrence à appliquer aux opérations de concentrations. En particulier, l'étude des mesures correctives requises pour réduire les effets négatifs des fusions devrait être enrichie, compte tenu des premières évaluations disponibles concernant cette pratique. Ainsi, la Federal Trade Commission aux Etats-Unis a publié en 1999 une étude[2] sur les effets des mesures correctives de type cessions obligatoires d'actifs imposées de 1990 à 1994, avec des résultats plutôt mitigés : les entreprises fusionnantes, aussi bien que l'acheteur des actifs transférés, ont tendance à agir selon des intérêts privés bien distincts des objectifs pro-concurrentiels poursuivis par l'autorité de concurrence, et environ 25% des mesures correctives ont complètement manqué leur but, malgré l'aval préalable reçu de la part de la Federal Trade Commission. En 2005, le Directorat Général Concurrence de la Commission Européenne a publié une étude similaire[3], avec une conclusion semblable: les mesures correctives ont été qualifiées d'efficaces dans seulement environ 57% des cas de fusions analysés. Au vu de ces résultats, il convient d'approfondir l'étude de l'interaction des autorités de concurrence avec les firmes fusionnantes lors de l'application de la politique de la concurrence.

L'objectif et le domaine de recherche de cette thèse

Les faits stylisés et les constats empiriques cités soulèvent des interrogations quant aux explications économiques de la baisse des profits après une fusion, sur les incitations à fusionner (ou non) qui en découlent, ou bien sur les contraintes qui pèsent sur le contrôle des concentrations et les stratégies à mettre en place par les autorités de la concurrence pour en améliorer le résultat.

L'objectif de cette thèse est de contribuer à l'analyse théorique des fusions acquisitions, en proposant des éléments de réponse aux questions précédentes. La première partie se pro-

[2] Federal Trade Commission, Bureau of Competition, A Study of the Commission's Divestiture Process, August 6, 1999

[3] European Commission, Merger Remedies Study, DG Comp, October 2005

pose d'approfondir l'étude positive des incitations privées motivant les stratégies de fusion des entreprises et des conséquences sur les marchés d'une telle décision. La deuxième partie examinera d'un point de vue normatif l'interaction stratégique entre les autorités de concurrence et les firmes fusionnantes, pour tirer des conclusions concernant le profile optimal du contrôle des concentrations.

De manière générale, la politique de la concurrence appliquée aux fusions acquisitions est largement dédiée aux transactions horizontales, entre concurrents directs sur un même marché. Cette thèse suivra cette tendance et étudiera exclusivement les concentrations horizontales, qui représentent par ailleurs la plupart[4] des opérations soumises au contrôle des autorités de concurrence, ceci en raison de leurs conséquences.

En effet, selon un récent rapport établi pour le Directorat Général Concurrence de la Commission Européenne[5], si elle ne génère pas de réductions de coût, une fusion horizontale conduit à une hausse du pouvoir de marché de toutes les firmes de l'industrie, ce qui se solde par des prix plus élevés et une production plus faible. En plus de cet effet "unilatéral", une concentration horizontale peut aussi menacer la concurrence en favorisant la collusion (tacite ou explicite) entre les firmes restant sur le marché (voir Selten (1977) par exemple pour l'effet collusif d'une réduction du nombre d'acteurs sur un marché).

Cette thèse examinera exclusivement les effets unilatéraux des concentrations et les réponses qui leur sont apportées par les autorités de concurrence.

Premièrement, ceci permettra d'étudier les incitations privées à fusionner indépendamment de la possibilité de réaliser ensuite un profit de collusion. De plus, l'analyse des effets anti-concurrentiels unilatéraux des concentrations permet de se concentrer sur les gains d'efficience, qui sont au cœur même du bilan concurrentiel établi par les autorités de concurrence lors de l'analyse d'une fusion (Motta (2004, p.271). La littérature économique avait détaillé l'impact des gains d'efficience sur le pouvoir de marché, la tarification et même l'existence d'un équilibre collusif sur le marché, ce qui a justifié par la suite leur prise en compte également dans la pratique. Ainsi, selon le Règlement CE N° 139/2004

[4] Selon le rapport Merger appraisal in oligopolistic markets préparé en 1999 pour Office of Fair Trading britannique, les concetrations horizontales représentaient 93% des transactions étudiées (97% en valeur).

[5] "The Economics of Unilateral Effects", M. Ivaldi, B. Jullien, P. Rey, P. Seabright et J. Tirole, Interim Report for DG Competition, 2003

du 20 janvier 2004 sur les concentrations, paragraphe 29, "Pour déterminer l'effet d'une concentration sur la structure de la concurrence dans le marché commun, il convient de tenir compte des gains d'efficacité probables démontrés par les entreprises concernées. Il est possible que les gains d'efficacité résultant de la concentration contrebalancent les effets sur la concurrence, et notamment le préjudice potentiel pour les consommateurs...".

Finalement, du point de vue de l'analyse du contrôle des concentrations, le choix d'examiner les conséquences unilatérales des fusions s'accompagne nécessairement d'une étude des mesures correctives imposées dans de tels cas. Cette thèse se concentre ainsi sur l'analyse des mesures correctives comme principal instrument de la politique de la concurrence appliquée aux concentrations horizontales. Par exemple, si à la fin des années 1980 les mesures correctives étaient utilisées seulement dans 23% des cas de fusion examinés par les autorités de concurrence américaines, elles le sont actuellement à hauteur de 60% (Parker et Balto (2000)). Au delà de ce constat, leur étude paraît également justifié par l'absence d'une "théorie" des mesures correctives, à la différence de la "théorie" des effets unilatéraux des concentrations, comme le fait remarquer le rapport "Merger appraisal in oligopolistic markets" établi en 1999 pour l'Office of Fair Trading britannique. Il convient d'approfondir l'étude théorique des effets et de l'application optimale des mesures correctives, étant donné le flou théorique et juridique qui concerne leur application (Blumenthal (2001)). Par ailleurs, les rapports établis pour les autorités de concurrence américaine et européenne (antérieurement cités) sur les résultats des mesures correctives témoignent de leur l'intérêt manifeste pour ce qui constitue actuellement leur plus grand défi dans le domaine du contrôle des concentrations (Parker et Balto (2000)).

Pour résumer, les analyses (positives ou normatives) proposées dans cette thèse sont centrées autour des effets unilatéraux des concentrations horizontales, parmi lesquels les gains d'efficience recevront une attention particulière, ainsi qu'autour des mesures correctives en tant que principal instrument de contrôle des concentrations par les autorités de la concurrence.

PREMIÈRE PARTIE: STRATÉGIES DES ENTREPRISES

La première partie de cette thèse se concentre sur l'analyse en cadre spatial et d'un point de vue positif des motivations et des conséquences des fusions acquisitions.

Chapitre 1

Le premier chapitre se propose d'argumenter l'idée qu'une analyse spatiale des concentrations horizontales permet d'avoir plus d'éclairage à la fois sur les motivations privées et les stratégies de fusion des entreprises, et sur la possible réponse des autorités de la concurrence.

Parmi les conséquences les plus visibles des fusions horizontales on compte les changements dans la gamme de produits offerts par les partenaires, ou bien le repositionnement géographique de filiales ou de points de vente dans le réseau de distribution. Ainsi, suite à l'acquisition en septembre 2005 de Riunione Adriatica di Sicurtà (RAS) S.p.A., le groupe d'assurance Allianz AG se propose de réorganiser son activité européenne, à commencer par la réduction numérique et la redistribution géographique de ses unités administrative allemandes à l'horizon 2008, ce qui devrait générer entre 500 et 600 million d'euros d'économies pour les clients et les actionnaires[6]. Mais un tel repositionnement spatial après une fusion horizontale peut également se manifester à travers la différentiation horizontale des produits. Berry et Waldfogel (2001) ont évalué les données de panel disponibles sur 243 marchés locaux américains des programmes radio avant et après la vague de concentrations déclenchée par la dérégulation du secteur en 1996. Leurs résultats montrent que les fusions entre les stations radio ont plutot bloqué l'entrée sur ce marché, mais la diversité des programmes proposés a augmenté. Cette conclusion en termes de différentiation des produits a permis à Berry et Waldfogel (2001) d'insister sur la prise en compte des changements dans la gamme de produits offerts pour les éventuelles décisions des autorités de concurrence concernant les fusions horizontales impliquant des biens différentiés.

L'espace, au sens géographique ou bien au sens de la gamme de produits, crée la différentiation. Les modèles de concurrence spatiale permettent de mieux appréhender les

[6] Source: http://www/allianz.com

conséquences des concentrations, dans la mesure où ils rendent possible la modélisation plus réaliste des changements structurels induits par la concentration dans la gamme des variétés ou du point de vue purement géographique. De la même façon, le cadre spatial est utile à l'analyse des stratégies de fusions déterminées soit par le degré de différentiation des produits offerts par les partenaires, soit par la géographie de leurs réseaux respectifs de distribution ou de production. Par ailleurs, la pertinence des analyses spatiales des fusions est reconnue par les autorités de concurrence, puisque toute évaluation des effets concurrentiels d'une concentration commence par l'identification du marché pertinent, soit-il géographique ou défini par l'ensemble des variétés de biens concernés.

A travers une revue de la littérature théorique portant sur les concentrations horizontales dans un cadre spatial, ce premier chapitre résumera aussi bien l'impact de la localisation sur les stratégies de fusions des entreprises, que celui de la concentration horizontale sur les choix de positionnement des entreprises dans l'espace géographique ou bien celui des produits. Mais qu'il s'agisse de décrire l'équilibre spatial initial qui incite à la fusion, ou bien la configuration spatiale qui résulte de l'équilibre post-fusion, notre analyse critique des modèles de concentration spatiale a nécessité d'abord une synthèse des principaux résultats de la théorie de la localisation stratégique en oligopole[7].

En discutant d'abord les modèles de fusions horizontales à localisation donnée, ce chapitre a souligné que leur motivation principale a été de vérifier la robustesse en cadre spatial des résultats obtenus sans la prise en compte de l'espace, en particulier le "paradoxe" de profitabilité et la possibilité de monopoliser le marché. En cadre non spatial, les contributions de Salant et al. (1983) et Szidaraovsky et Yakovitz (1982) ont formalisé le

[7] On peut résumer les principaux résultats des modèles de localisation stratégique en oligopole de la manière suivante: la localisation optimale d'une entreprise est déterminée par son choix de tarification, la forme de la fonction de demande, les coûts de production et transport, la distribution spatiale des consommateurs, et l'intensité de la concurrence. De manière générale, les prédictions des modèles de localisations stratégiques sont fortement sensibles à des modifications d'hypothèses sous-jacentes, mais néanmoins, la localisation optimale sera toujours le résultat d'un arbitrage entre les forces d'agglomération (effet taille de marché, existence d'un point central, externalités positives entre entreprises) et les forces de dispersion (concurrence accrue, substituabilité stratégique entre les variétés proposées). Pour résumer, le choix optimal de localisation exige la minimisation des coûts de transport, puisque l'entreprise choisit la distance qui la sépare des consommateurs de manière à maximiser son profit.

constat empirique d'une baisse du profit joint pour les entreprises fusionnantes dans le cas d'une concurrence *à la Cournot* avec bien homogène, sous des hypothèses habituelles de linéarité des coûts et de la demande, et en absence de gains d'efficience (voir également Deneckere et Davidson (1985) pour le cas contraire, profitable, d'une fusion avec concurrence en prix). De plus, qu'il s'agisse d'une concurrence en quantités ou en prix, les firmes extérieures à la fusion y gagnent plus que les participants (Stigler (1950)), ce qui soulève la question de la rationalité même de la concentration, surtout dans le cas de la concurrence en quantités[8]. Par ailleurs, la prise en compte de cet effet de "passager clandestin" de la part des entreprises non participantes a permis de mettre en évidence l'impossibilité de monopoliser le marché dès lors que la décision de fusionner est endogénéisée (l'effet de "hold-up" en littérature - voir Kamien et Zang (1991) et Kamien et Zang (1993)).

En raison de l'équivalence entre la différentiation horizontale des produits et la différentiation au sens spatial, les analyses en cadre spatial des fusions horizontales avec concurrence *à la Bertrand* ont pu retrouver la conclusion de profitabilité (Levy et Reitzes (1992)), mais ont également montré que l'effet de "hold-up" est affaibli ou disparaît quand la concurrence est localisée et ne concerne que les entreprises voisines (Reitzes and Levy (1995), Brito (2003), Giraud-Héraud et al. (2002)). Du point de vue de l'application du contrôle des concentrations, ces modèles ont permis de rappeler l'importance de la définition du marché pertinent, puisque dans le cas d'une concurrence spatiale localisée, les mesures de concentration du marché ne fournissent que peu d'information par rapport à la prise en compte des marchés locaux, puisque les fusions entre des substituts proches augmentent nécessairement le pouvoir de marché et donc l'indice de concentration[9].

Bien que le cadre spatial introduise la différentiation des produits dans les modèles de

[8] Plus précisément, puisque les prix sont des compléments stratégiques, la hausse du prix suite à la concentration incite les concurrents à augmenter leurs prix en réponse (voir Gaudet et Salant (1992) pour l'importance de la complémentarité stratégique), tandis que les quantités étant des substituts stratégiques, la contraction de l'output joint des partenaires induit une expansion de celle des concurrents, ce qui limite la hausse du prix sur le marché et *in fine* rend la fusion non profitable.

[9] Ceci a constitué un des points importants de révision des Merger Guidelines américaines en 1984, qui ont conclu que les vendeurs ne se retrouvent en concurrence directe qu'avec certains de leurs concurrents quand les produits sont différentiés ou bien quand les vendeurs sont dispersés dans l'espace.

fusions horizontales avec concurrence en quantités et localisations données, le "paradoxe" de profitabilité n'est pas résolu, puisque l'hypothèse de discrimination spatiale qui caractérise les modèles *à la Cournot* conduit à la segmentation des marchés locaux, et par conséquent chaque point dans l'espace (ou marché local) se retrouve soumis au paradoxe de profitabilité de manière identique au cadre non-spatial (McAfee et al. (1992), Norman et Pepall (1998, 2000), Matsushima (2001,b)).

Cette conclusion a motivé en partie l'approche alternative à l'égard de l'analyse des concentrations en cadre spatial, à travers la prise en compte des décisions de (re)localisation (ou choix de produit).

La littérature spatiale qui endogénèise la décision de localisation permet en effet de tirer des conclusions sur l'impact de la décision de fusion sur le comportement des entreprises, qu'il soit antérieur ou postérieur à la concentration.

De manière générale, le choix de localisation, spatiale ou dans la gamme des produits, en anticipation d'une fusion horizontale, obéit à une logique stratégique de réduction de l'effet "passager clandestin" (Rotshchild et al. (2000), Heywood et al. (2001)), ou alors de maintien d'un prix élevé après la fusion (Gupta et al. (1997), Ecer (2005)). Par ailleurs, ce timing (localisation optimale avant la fusion[10] conduit à une perte d'efficience dans la mesure où la différentiation (spatiale, ou en termes de produits) qui en résulte ne minimise pas les coûts de transport (ou la désutilité) des consommateurs.

Ceci constitue une différence essentielle par rapport aux modèles de fusions horizontales avec choix de localisation ex-post, qui par définition obéit à l'objectif de maximisation du profit joint des partenaires et donc de minimisation du coût de transport.

De ce point de vue, endogénéiser la décision de localisation après la concentration permet de modéliser des gains d'efficience endogènes, ce qui suggère une possible solution au paradoxe de profitabilité des fusions *à la Cournot*. En effet, Norman et Pepall (2000) ont pu montrer que sur le marché linéaire *à la Hotelling,* la possibilité pour les partenaires de se rélocaliser ex-post permet d'aboutir à une fusion profitable, même si les rivaux

[10] Ceci est pertinent quand le choix de localisation est équivalent par exemple à celui d'investissement, habituellement pris avant une fusion, et qui se trouve modifié en raison de la concentration qui s'ensuit (voir Gatsios et Karp (1992) par exemple).

continuent à gagner davantage.

De plus, ce cadre d'analyse permet une étude plus réaliste des concentrations horizontales, dans la mesure où il nécessite la modélisation des entreprises multi-produit ou multi-filiale[11], qui maximisent leur profit global en prenant en compte l'intéraction stratégique entre leurs composantes (substituabilité ou distance géographique plus ou moins importante – voir Sarkar et al. (1997), mais aussi Martinez-Giralt et Neven (1988) et Janssen et al. (2003)).

En passant en revue les contributions théoriques sur ces thèmes, ce chapitre s'est proposé d'argumenter l'intérêt d'utiliser un cadre spatial pour l'analyse des concentrations horizontales, et a permis en même temps de présenter et de délimiter la problématique des chapitres 2 et 3. Ainsi, le chapitre 2 vérifie la robustesse de la solution "spatiale" proposée par Norman et Pepall (2000) au paradoxe de profitabilité des fusions dans le cas de la concurrence en quantités, tandis que le chapitre 3 étudie la stratégie optimale de concentration horizontale quand sont possibles non seulement l'acquisition et la relocalisation optimale des filiales, mais également leur cession stratégique vers des concurrents.

Ces deux chapitres traitant du choix optimal de localisation après fusion partagent une même formalisation de base, à savoir un modèle de concurrence en quantités avec discrimination spatiale où les entreprises prennent en charge la livraison de leur produit jusqu'à la localisation des consommateurs. D'un côté, ceci constitue une approche réaliste puisqu'elle permet de retrouver des effets constatés tels que la segmentation des marchés (Brander et Krugman (1983)), l'agglomération spatiale des points de vente/production appartenant à des entreprises rivales (Pal et Sarkar (2002)), ou bien le chevauchement de leurs aires commerciales (Phlips (1983), McBride (1983)). De l'autre, ce cadre de modélisation reproduit le principe des systèmes de production flexibles (Eaton et Schmitt (1994)) où la firme ajuste le produit de base (ici, sa localisation), moyennant un certain coût pour l'adapter au mieux aux préférences d'un consommateur (ici, le coût de transport pour la livraison à la localisation du consommateur final).

[11] Ce qui est cohérent avec la réalité de tous les jours, compte tenu de fonctionnement de nombreuses entreprises d'hotellerie, restauration, grande distribution, chaînes de stations services, etc.

Chapitre 2

Dans ce chapitre, la question de la localisation optimale post-fusion a été étudiée dans un modèle d'oligopole de Cournot dans la ville circulaire, dans le but de tester la validité de la solution spatiale qui avait été proposée au paradoxe de profitabilité des fusions horizontales. Dans un cadre non-spatial, on a pu expliquer ce manque de profitabilité par l'incapacité des partenaires de la fusion à assurer un output suffisant post-fusion, dû à la fois à la substituabilité stratégique impliquée par la concurrence en quantités (Salant et al. (1983)), par le manque d'avantage comparatif en termes de coûts de production de la nouvelle entité (Perry et Porter (1985)) et la simultanéité des décisions de production (Daughety (1990) ayant montré que le comportement de meneur de Stackelberg après fusion suffit à la rendre profitable).

Le cadre spatial, et plus précisément la ville linéaire a apparemment résolu le problème pour des niveaux suffisamment élevés de concentration (au plus huit firmes sur le marché), pourvu que les entreprises qui fusionnent aient la possibilité de se relocaliser après la fusion (Norman et Pepall (2000)). Ceci donne l'opportunité non seulement d'économiser les coûts de transport et de rationaliser la production entre les filiales, mais également de justifier de manière endogène une réduction du coût de livraison pour certains marchés locaux (ceux situés vers les extrémités du segment), ce qui constitue un avantage comparatif spatial par rapport aux concurrents. Pour citer Norman et Pepall (2000, p.668), "la localisation est un facteur clé pour expliquer le fait que la fusion peut conduire à une entreprise plus grande et plus efficace", avec l'idée de fond que la possibilité pour l'entreprise résultant de la fusion de repositionner ses variétés dans l'espace des produits (ou bien ses filiales dans l'espace géographique) serait une condition suffisante pour garantir la profitabilité de la concentration.

En considérant, en contraste, le cas de la ville circulaire, ce chapitre démontre que la possibilité de relocalisation ne constitue pas à elle seule la solution au paradoxe de profitabilité, mais que ce sont les caractéristiques de marché linéaire qui permettaient cette conclusion.

Plus précisément, la fusion accompagnée de relocalisation s'avère profitable sur le marché linéaire en raison de l'existence des extrémités exogènes et des effets de bord

qui en découlent, qui font que la stratégie dominante de localisation des rivaux, des firmes mono-filiales, soit la même qu'avant la fusion, au centre du segment (Anderson et Neven (1991), Pal et Sarkar (2002)). Par conséquent et suite à la relocalisation plus proche des extrémités du segment, les deux partenaires retrouvent un avantage de coût de livraison sur ces marchés plus éloignés des rivaux mais plus proches maintenant de leurs propres localisations.

En contraste, le cas de la ville circulaire correspond à un espace parfaitement homogène, où les différents marchés locaux ne sont pas différentiés par leur distance vis-à-vis des extrémités (inexistantes), et où il n'y a pas de localisation universellement préférée qui minimiserait le coût de transport, telle le milieu du segment. Sur un tel marché circulaire, l'équilibre initial avant une fusion horizontale est ainsi plus ou moins dispersé (l'agglomération totale des entreprises n'est pas un équilibre de localisation sur le cercle - voir Pal (1998), Matsushima (2001,a) et Shimizu et Matsumura (2003)), car l'entreprise n'a pas de stratégie dominante de localisation, tout dépend de la localisation des rivaux. Par conséquent, les profits individuels réalisés avant la fusion sont plus élévés que dans le cas du marché linéaire, ce qui rend plus difficile à satisfaire la condition de profitabilité de la concentration. En effet, la relocalisation post-fusion ne peut assurer une demande captive que dans le cas bien particulier de la fusion vers duopole, où les deux partenaires font face à un seul rival, et donc peuvent livrer leur output à un coût plus faible aux localisations diamétralement situées par rapport à celle du rival.

La deuxième étape de notre démonstration consiste en l'analyse du cas de fusion bilatérale vers triopole. Puisque ex-post l'entité fusionnée affronte deux rivaux, l'équilibre de relocalisation après fusion ne lui permet plus de s'aménager une demande captive entre les localisations de ses filiales, car chacune se retrouve symétriquement encadrée par les deux concurrents.

En d'autres termes, on montre qu'un marché dépourvu de niches à exploiter, dont la ville circulaire constitue une approximation, n'assure la profitabilité des fusions horizontales que pour des niveaux de concentration très élevés (monopole ou duopole)[12]. Malgré

[12] Cette intuition reste une conjecture pour le cas général, à n firmes, mais étant donné que la profitabilité des fusions augmente avec le niveau de concentration sur le marché, il est difficile d'imaginer l'intuition

la réduction de coût conférée par la relocalisation, sur un tel marché il n'y a pas la possibilité de s'assurer une demande captive, ce qui explique le manque de profitabilité de la fusion.

Ainsi, le premier résultat de ce chapitre est de montrer que l'hypothèse sur la forme de l'espace est déterminante pour l'analyse de profitabilité des fusions horizontales entre entreprises se livrant à une concurrence spatiale en quantités. Par ailleurs, notre test de robustesse de la solution spatiale proposée par Norman et Pepall (2000) constitue une confirmation d'un corollaire de l'analyse de Deneckere et Davidson (1985), selon lequel la profitabilité et les incitations à fusionner sont plus faibles dans le cas des marchés où l'intensité de la concurrence est plus symétrique, tel le marché circulaire.

En plus de ce résultat principal, ce chapitre en propose également deux autres. D'un coté, notre analyse rappelle l'importance pour l'étude des concentrations de la définition du marché pertinent, puisque les conclusions dépendent de la forme de l'espace retenue comme hypothèse de travail. Il convient en effet de ramarquer que les deux représentations spatiales, linéaire et circulaire, correspondent chacune à des situations réelles. Ainsi, le marché linéaire correspond de manière générale à la différentiation des produits qui permet d'avoir un consommateur médian unique. Il n'existe pas de telle analogie pour le marché circulaire, qui correspond en retour au cas où une même variété représente la variété idéale d'un consommateur et en même temps la variété la moins aimée par un autre (Horstmann et Slivinski (1985)). Par ailleurs, d'autres situations sont formalisées à travers le marché circulaire, telles que les centre-villes encombrés par des embouteillages qui forcent les consommateurs - acheteurs à les contourner plutôt que de les traverser, ou bien des compagnies aériennes ou des chaînes média (radio ou télévision) qui choisissent les horaires des vols ou de leurs programmes sur le cadran horaire.

Par ailleurs, ce chapitre contribue à l'analyse de l'équilibre de localisation sur le marché circulaire dans le cas de la concurrence entre entreprises multi-produit/filiale, qui reste à présent largement non résolu[13]. On montre que la propriété d'équilibres de localisation

pour justifier la profitabilité des fusions pour des marchés bien moins concentré que le triopole.

[13] En effet, si sur le marché linéaire, Pal et Sarkar (2002) ont exhaustivement résolu ce problème, pour le marché circulaire seulement le cas du duopole symétrique bi-filiale avait été étudié par Chamorro-Rivas (2000).

multiples de l'espace circulaire, déjà vérifiée dans le cas de la concurrence entre firmes mono-filiale (Gupta et al. (2004)), reste valide dans le cas des entreprises multi-filiales, car la fusion horizontale donne naissance à une telle entreprise, et pour les deux cas étudiés (fusions vers duopole et vers triopole), des équilibres doubles ont été obtenus post-fusion.

Chapitre 3

Si la théorie conclue que, souvent, les incitations à fusionner sont plutôt faibles, les constats empiriques sont nombreux à confirmer le manque de profitabilité de beaucoup de fusions acquisitions (Banerjee et Eckard (1998) par exemple). Ceci a soulevé au niveau théorique le défi d'expliquer pourquoi la concentration sur les marchés se poursuit, malgré la probabilité de contracter un "mariage décevant" selon les mots de Meeks (1977).

Les premières pistes théoriques ont été fournies par des modèles qui ont fait l'hypothèse que les actionnaires manquent de moyens pour discipliner les managers qui surestiment leur capacités (Roll (1986)), ou bien qui privilégient un objectif de taille de l'entreprise à la place de la maximisation du profit (Shleifer et Vishny (1986)). Plus récemment, Fridolfsson et Stennek (2002) en cadre non spatial et Brito (2003) sur le marché circulaire de Salop ont mis en évidence une justification défensive pour les concentrations non profitables. En endogénéisant la décision de fusionner, et compte tenu du fait que les rivaux ne profitent pas tous de l'effet de "passager clandestin", ils ont pu montrer que la fusion horizontale, même si non profitable, est préférée à l'alternative, pire du point de vue du profit ex-post, de se retrouver dans la situation du rival qui ne profite pas (ou qui profite le moins) de la concentration.

Le troisième chapitre de cette thèse s'inscrit dans cette problématique dans la mesure ou nos résultats suggèrent une explication alternative. A travers un exemple de fusion horizontale en cadre spatial, ce chapitre montre la rationalité d'entreprendre une concentration, même non profitable, pourvu qu'elle soit une étape dans une stratégie plus complexe de hausse de la profitabilité[14]. Plus précisément, on s'intéresse à la stratégie optimale d'intégration horizontale quand l'acquisition des filiales mais également leur cession

[14] Weston (2001) remarquait qu'il est bien restrictif de supposer que les stratégies de restructuration des corporations se réduisent à des fusions acquisitions, alors que les cessions d'actifs et les scissions en divisions indépendantes sont également possibles.

sont des actions possibles.

Pour ce faire, on construit un exemple sur le marché linéaire où la fusion horizontale et la création de divisions indépendantes permet d'obtenir un profit plus élevé que la seule fusion, à condition que la relocalisation optimale ex-post soit possible. Ce chapitre examine ainsi en cadre spatial avec choix de localisation la relation entre l'intégration des filiales suite à la fusion et leur gestion décentralisée sous la forme d'une scission en divisions indépendantes, en tant qu'étapes successives d'un processus de restructuration profitable.

D'un point de vue empirique, les vagues de fusions sont suivies d'une activité accrue de création de franchises ou de transferts de filiales entre entreprises rivales, comme ont pu conclure Maksimovic et Phillips (2001) ou Mulherin et Boone (2000). Néanmoins, d'un point de vue théorique, les stratégies d'intégration horizontale et de cession des filiales sont non seulement opposées par leur contenu même, mais aussi non profitables simultanément pour des entreprises se faisant concurrence en quantités. En effet, si l'incapacité de maintenir un output élevé (due à la substituabilité stratégique) rend la fusion non profitable, la scission en divisions indépendantes est équivalente au comportement de meneur de Stackelberg, et sur un marché *à la Cournot* une entreprise aura intérêt à créer des franchises tant que la stratégie de fusion n'est pas profitable (sous des hypothèses usuelles de linéarité des coût et de la demande – voir Polasky (1992), Baye et al. (1996)).

En utilisant le cadre spatial, ce chapitre contredit cette opposition. Notre analyse prend comme point de départ un triopole de Cournot dans la ville linéaire, sous des hypothèses habituelles de discrimination spatiale et de coût de livraison à la charge des entreprises. Dans notre exemple, la fusion bilatérale conduira à une entité disposant de quatre filiales.

Dans un premier temps, on identifie l'équilibre de relocalisation post-fusion et on étudie la profitabilité de la concentration, en comparant les profits avant et après[15].

Ensuite, en comparant du point de vue de l'équilibre de localisation et des profits correspondants les stratégies de gestion complètement indépendante ou seulement partiellement centralisée des filiales, on démontre que la cession d'actifs suivant une fusion

[15] Compte tenu des étapes choix de localisation - choix de quantités qu'on considère avant et après la fusion, mais aussi après la scission en division indépendantes, il s'agit à chaque fois de résoudre d'abord le sous-jeu en quantités, de manière ensuite à maximiser par rapport à la localisation choisie le profit total réalisé sur l'ensemble des marchés locaux représenté par le segment.

horizontale peut augmenter la profitabilité de celle-ci. Plus précisément, on montre que le profit post-fusion est le plus élevé dans le cas où l'entité fusionnée se scinde en deux divisions indépendantes, chacune gérant de manière centralisée la production et la localisation de ses deux filiales.

Ce résultat principal de notre papier est dû au cadre spatial retenu, puisque la séquence de stratégies permet d'optimiser les gains d'efficacité disponibles à travers la relocalisation (économies de coût de transport et rationalisation de la production entre filiales). En effet, la relocalisation optimale post-fusion des quatre filiales génère des économies de coût, mais l'effet de réduction d'output est toujours présent sur chaque marché local, en raison de la substituabilité stratégique. Par conséquent, en procédant à la scission en divisions indépendantes mais multi-filiales, l'entreprise fusionnée adopte un comportement de Stackelberg et s'engage de manière crédible à maintenir un output élevé, tout en profitant de l'avantage de localisation conféré par le choix optimal de localisation au sein de chaque division[16].

Par ailleurs, ce résultat de complémentarité entre la concentration et la scission en divisions indépendantes reste valable dans le cas où la fusion initiale n'est pas profitable, ce qui revient à dire que les entreprises peuvent avoir intérêt à fusionner et subir une baisse initiale du profit joint juste pour mieux décentraliser ensuite et augmenter finalement leur profit[17].

Le cadre d'analyse de la ville linéaire permet également une autre interprétation de ce résultat. En effet, l'équilibre spatial obtenu après la scission de l'entreprise fusionnée coïncide avec le résultat d'une injonction de cession d'actifs vers un nouvel entrant, imposée par l'autorité de la concurrence en raison des effets négatifs de la fusion initiale sur les consommateurs de la ville linéaire (hausse du prix)[18]. En d'autres termes, notre résultat

[16] Notre exemple correspond en réalité aux pratiques de franchise, où la firme-parent (holding) garde le droit exclusif d'établir de filiales, mais les décisions de production et de choix de produit (localisation, ici) sont décentralisées au niveau de celles-ci.

[17] Notre intuition est robuste à un changement du nombre de filiales de l'entreprise rivale restant sur le marché, comme le montre le deuxième exemple développé dans l'annexe B qui aboutit aux mêmes conclusions.

[18] Pour justifier une telle intervention, dans ce chapitre on fournit également la comparaison des prix entre la situation initiale, l'intégration totale des filiales par la fusion et leur gestion partiellement décentralisée

sur la stratégie la plus profitable d'intégration horizontale a un corollaire relatif à l'effet des mesures correctives sur la profitabilité de la concentration. Notre exemple montre que les remèdes structurels des fusions (les cessions obligatoires d'actifs) ne sont pas forcément coûteux pour les firmes qui fusionnent et les subissent, même lorsqu'ils remplissent leur rôle correcteur quant aux effets anticoncurrentiels de la fusion (ce qui est le cas dans notre modèle[19]).

Pour résumer, grâce au cadre spatial retenu, ce chapitre explique l'incitation à fusionner par l'opportunité de mieux décentraliser ou transférer des actifs et ainsi augmenter la profitabilité de la fusion, ce qui suggère finalement une justification pour les fusions apparemment non-profitables qui sont observées de manière récurrente. En même temps, l'analyse proposée ouvre une piste de réflexion sur les effets réels de cet instrument de la politique de la concurrence que sont les mesures correctives, étant donné la possibilité qu'ils améliorent plutôt qu'ils pénalisent le résultat d'une concentration.

DEUXIÈME PARTIE: STRATÉGIES DES AUTORITÉS DE CONCURRENCE

La deuxième partie de la thèse est consacrée à 'analyse normative des stratégies des autorités de concurrence, afin d'étudier le profil optimal du contrôle des concentrations.

Chapitre 4

Ce chapitre constitue l'introduction à la problématique de l'analyse normative des fusions horizontales. Pour cette raison, ce chapitre se propose de dresser la synthèse des fondements théoriques du contrôle des concentrations mais aussi le bilan des résultats obtenus en pratique par les autorités de concurrence.

La politique de la concurrence relative aux concentrations horizontales vise à éviter la hausse du pouvoir de marché suite à une fusion, qui serait préjudiciable au déroulement de la concurrence et aux intérêts des consommateurs. Compte tenu du fait que les incitations privées à fusionner ne correspondent pas nécessairement à des stratégies d'amélioration

suite à la scission. Cette mesure corrective est justifiée, puisque sans elle le prix augmente, et elle est efficace, car elle fait diminuer le prix.

[19] Voir Cabral (2003) pour un modèle spatial où les mesures correctives ne sont pas efficaces.

du bien-être des consommateurs sur des marchés en situation d'oligopole, le contrôle des concentrations a été instauré de manière à limiter au mieux les conséquences négatives pour la concurrence des concentrations qui ont effectivement lieu. Ainsi, les autorités en charge du contrôle des concentrations, telles la Commission Européenne ou le Département de Justice et la Federal Trade Commission aux Etats-Unis doivent apporter des réponses à deux questions centrales pour la politique de la concurrence, à savoir est-ce que la concentration soulève un problème de concurrence, et quels sont les meilleurs moyens pour le résoudre.

Pour répondre à la première question, les autorités de la concurrence procèdent à une évaluation des concentrations. Celle-ci prend la forme d'un bilan concurrentiel, au terme duquel la fusion est soit déclarée concurrentielle, c'est-à-dire compatible avec le jeu de la concurrence sur le marché, ou bien anti-concurrentielle, dans quel cas elle sera soit interdite soit soumise à des injonctions visant à réduire ses effets négatifs pour la concurrence et les consommateurs, sous la forme de mesures correctives. Compte tenu de l'importance grandissante des analyses économiques du contrôle légal des concentrations, à la fois pour leur bilan concurrentiel et pour le choix des mesures correctives, ce chapitre se concentre sur les fondements théoriques qui ont inspirés les pratiques actuelles des autorités de la concurrence, en mettant en évidence le rôle central des aspects informationnels et incitatifs pour l'applicabilité et le succès des procédures en pratique.

Une information essentielle pour le bilan concurrentiel d'une concentration concerne les gains d'efficacité potentiels générés par la mise en commun des actifs et méthodes de fonctionnement des partenaires[20]. Ces gains d'efficacité se matérialisant sous la forme de réductions de coût, et leur connaissance permet de mieux évaluer l'effet concurrentiel net de la fusion. Celui-ci est le résultat de l'arbitrage entre la hausse du pouvoir de marché par

[20] Voir le Règlement CE N° 139/2004 du Conseil relatif au contrôle des concentrations entre entreprises, Journal Officiel de l'Union européenne L24/1:

"Le présent règlement prévoit [...] que toute concentration qui entraverait de manière significative une concurrence effective [...] devrait être déclarée incompatible avec le marché commun [...] ce qui devrait être interprété au-delà du concept de dominance" (paragraphe 25) et "Pour déterminer l'effet d'une concentration sur la structure de la concurrence dans le marché commun, il convient de tenir compte des gains d'efficacité probables démontrés par les entreprises concernées." (paragraphe 29).

la réduction du nombre d'entreprises sur le marché et ces réductions potentielles du coût avec lequel opérera la nouvelle entité, comme l'avait montré l'analyse de Williamson (1968) en termes d'efficacité productive et inefficacité allocative d'une concentration horizontale.

Néanmoins, ce rapprochement entre la théorie et la pratique du contrôle des concentrations soulève certains problèmes concrets, étant donné la nature immatérielle au moment du bilan concurrentiel des gains d'efficacité argumentés par les entreprises concernées. Selon Ilzkovitz et Meiklejohn (2001), ces problèmes concernent le choix du critère de bien-être pour la prise en compte des gains d'efficacité, le calcul du seuil minimal que ces gains devraient satisfaire pour aboutir à un effet pro-concurrentiel de la concentration, les procédures d'évaluation effective, la charge de la preuve de leur existence et finalement la vérification de leur matérialisation après la fusion.

En ce qui concerne le critère utilisé pour le bilan concurrentiel, la pratique retient le bien-être des consommateurs, puisque pour être déclarée acceptable une fusion doit conduire à des gains d'efficacité et donc réductions de coût suffisant(e)s pour garantir que le surplus des consommateurs ne diminuera pas. Ce choix a été formellement argumenté par des analyses économiques qui montrent que ce faisant, le contrôle des concentrations permet d'atteindre un niveau plus élevé de bien-être global. Ceci est expliqué par une vue dynamique qui anticipe les fusions plus efficaces qui seraient autrement découragées (Lyons (2002)), ou bien par l'existence d'une asymétrie d'information entre l'autorité de concurrence et les entreprises qui fusionnent, qui crée un biais en faveur des profits des firmes qui serait atténué par le critère favorable aux consommateurs (Besanko et Spulber (1993)[21]).

En termes de gains d'efficacité acceptables, la théorie économique a montré la nécessité de distinguer entre les réductions de coût marginal de production, qui se répercutent sur le prix final et donc sur le bien-être des consommateurs, et les économies de coûts fixes, qui ne devraient donc pas faire partie des gains d'efficacité admissibles. Théoriquement, ceci a été argumenté par l'analyse de Farrell et Shapiro (1990,a), qui dans le modèle usuel de concurrence en quantités ont pu montrer que seules les réductions de coût marginal de

[21] Voir également les analyses de Neven et Röller (2005) et Farrell (2003) qui conduisent à la même conclusion.

type synergies entre les partenaires permettent d'éviter une hausse du prix sur le marché post-fusion. Néanmoins, des contributions théoriques plus récentes ont permis de nuancer cette conclusion. En effet, une fusion horizontale sans synergies peut améliorer ex-post le bien-être des consommateurs pourvu que l'analyse prenne en compte l'encombrement du marché (Häckner et Razo (2004)), ou bien l'avantage du partage de l'information pertinente sur les coûts par les partenaires lors de la fusion (Stennek (2001)), ou même le seul aspect stratégique de l'annonce de fusion en tant que signal pour les firmes rivales, celui d'une entité possiblement plus efficace et agressive, face à laquelle il convient de réduire sa propre production (Amir et al. (2004)).

Quoi qu'il en soit, la pratique du contrôle des concentrations suit les recommandations théoriques également en ce qui concerne la charge de la preuve de ces gains d'efficacité, qui revient aux entreprises qui fusionnent (Gonzalez (2004)). Par ailleurs, ceci est appuyé par la reconnaissance du fait que les partenaires ont une meilleure information sur les caractéristiques de leur fusion, ce qui renvoie aux problèmes soulevés par l'asymétrie d'information entre l'autorité de la concurrence et les entreprises qui fusionnent en ce qui concerne les gains d'efficacité et donc l'effet concurrentiel de la concentration.

Pour commencer, ce problème informationnel peut inciter l'autorité de la concurrence à un contrôle 'trop' strict des concentrations, dans le but de minimiser la possibilité d'accepter à tort des fusions. Mais ceci peut également décourager certaines fusions efficaces à l'avenir, comme le montre les analyses de Motta et Vasconcelos (2003) ou Razo (2004) qui considèrent le point de vue dynamique du contrôle des concentrations. Par ailleurs, l'asymétrie d'information mentionnée engendre des coûts substantiels de procédure lors du bilan concurrentiel de la fusion, en termes d'évaluation effective ou de transmission crédible d'une information fiable, ce qui peut éventuellement questionner la rationalité même de la de la prise en compte des gains d'efficacité (Lagerlöf et Heidhues (2005)).

Néanmoins, ce même problème informationnel incite aussi à l'étude, au moins théorique, des modalités possibles pour résoudre cette asymétrie d'information, avec des propositions de mécanismes de révélation inspirés par la théorie des contrats (voir Faulli-Oller et Corchon (1999), Röller et al. (2001), Gonzalez (2003), ou bien l'analyse proposée dans le

chapitre 6 de cette thèse). En pratique, de tels mécanismes n'ont pas (encore) été explorés, même s'il a été suggéré par exemple de procéder à une vérification ex-post des annonces de gains d'efficacité des entreprises, ce qui revient à rendre des décisions d'acceptation temporaires des fusions (Scherer (1991)). Cela est considéré comme prohibitif, compte tenu des coûts d'audit engendrés, de l'impossibilité vraisemblable de défaire ex-post une fusion consommée, ou bien des conséquences qui résultent de l'application d'une réglementation instable et incertaine. Il convient pourtant de reconnaître que l'utilisation des mécanismes de révélation aurait entre autres l'avantage de conduire à l'application de mesures correctives plus appropriées. En effet, sans une évaluation correcte du dommage concurrentiel de la concentration, qui nécessite la connaissance de l'ampleur exacte des gains d'efficacité potentiels, les mesures correctives censées réparer ce dommage ont moins de chances de succès.

A l'issue du bilan concurrentiel, une fusion sera soit acceptée, soit rejetée, soit approuvée sous conditions, ce qui revient à lui imposer certaines mesures correctives sous la forme de transferts obligatoires d'actifs (mesures structurelles) ou bien sous la forme de contraintes sur son comportement futur (injonctions comportementales). De manière générale, les mesures correctives sont des "engagements" de la part des entreprises qui fusionnent et qui permettront de résoudre le problème de concurrence soulevé par la fusion dans sa forme initiale. Mais la possibilité qui en découle pour les autorités de concurrence de modifier la structure de marché post-fusion en exigeant des mesures correctives rapproche le contrôle des concentrations de la réglementation (voir Rey (2003, p.130), ou Motta et al. (2003)).

Actuellement, les mesures correctives constituent l'instrument de prédilection des autorités de concurrence en général. Ceci s'accompagne d'un nombre de principes globalement acceptés pour l'application des mesures correctives, qui ont été résumé par le rapport OCDE 2004 sur les mesures correctives. Ainsi, lors du recours aux mesures correctives, le dommage pour la concurrence doit être certain et incontestable, les mesures correctives doivent représenter le moyen le moins contraignant pour restaurer la concurrence à son niveau initial, et n'ont pas à répondre à des objectifs de politique industrielle ou autres non reliés au problème de concurrence soulevé par la fusion.

En pratique, l'interprétation donnée à ces principes est la suivante. Pour commencer, les mesures correctives doivent êtres nécessaires, ce qui impose à l'autorité de la concurrence la charge de la preuve du dommage concurrentiel provoqué par la fusion. Par la suite, lors de l'analyse des mesures correctives proposées par les entreprises concernées, l'autorité de contrôle s'intéressera à leur efficacité et aux coûts d'implémentation associés, mais aussi à leur proportionnalité par rapport à l'ampleur du dommage concurrentiel, de manière à ne pas aller au-delà de l'objectif de réparation dans la modification imposée au marché post-fusion[22]. De plus, étant donné le souci de minimiser les coûts d'implémentation des mesures correctives, en pratique les autorités de concurrence montrent une préférence incontestable pour les remèdes structurels des fusions horizontales, sous la forme de transferts obligatoires d'actifs, qui ne nécessitent pas d'audit ex-post comme dans le cas des engagements de comportement.

Mais, comme pour toute intervention ex-ante sur un marché, l'impact final des remèdes des fusions est toujours incertain dans une certaine mesure. Ex-post, l'évaluation des mesures correctives en termes de réussites ou échec reste encore à parfaire, compte tenu du nombre très limité d'études ex-post sur le sujet. En effet, la première initiative dans cette direction est l'étude réalisée en 1999 par la Federal Trade Commission américaine sur la base d'entretiens avec les acheteurs des actifs transférés dans des cas de fusions avec mesures correctives structurelles entre 1993 et 1997. Les données indiquent qu'environ 75% des remèdes appliqués ont été efficaces. Une conclusion comparable est obtenue par l'étude similaire réalisée par le Directorat Concurrence de la Commission Européenne en 2003, sur la base d'un échantillon plus ample mais suivant la même méthodologie que l'étude américaine. Sur les 96 cas de fusions acceptées avec conditions entre 1996 et 2000, 57% ont été considérés comme efficaces. Compte tenu de la similarité de ces deux seules études qualitatives, il serait intéressant de pouvoir comparer leurs résultats avec ceux d'études quantitatives. Pourtant, il n'existe pas d'analyses économétriques systématiques sur la réussite ou l'échec des mesures correctives.

[22] De ce point de vue, le Règlement Européen de 2004 relatif au contrôle des concentrations est clair : "Ces engagements devraient être proportionnels au problème de concurrence et le résoudre entièrement" (paragraphe 30).

En théorie, les transferts d'actifs de la part des partenaires à destination d'autres firmes de l'industrie ou de nouveaux entrants peuvent ramener la concurrence sur le marché à un niveau comparable à celui d'avant la fusion (voir Farrell et Shapiro (1990,b) ou Medvedev (2004,a)). Néanmoins, de tels transferts d'actifs au sein d'une industrie peuvent également avoir des effets moins désirables, encourageant par exemple la collusion par la symétrie accrue de la structure de marché à laquelle ils conduisent (Compte et al. (2002), Vasconcelos (2005,a)).

Par ailleurs, il convient de tenir compte aussi des diverses incitations qui accompagnent nécessairement l'application des mesures correctives. Du point de vue des autorités de la concurrence, les remèdes des fusions procurent l'occasion d'agir directement sur la structure (et aussi sur le comportement) des entreprises, d'où une possible incitation à utiliser les mesures correctives pour améliorer la performance du marché en question, au lieu de simplement corriger les effets négatifs de la concentration (Farrell (2003), Vasconcelos (2005,b)). Du point de vue des entreprises qui fusionnent, et compte tenu de leur information privée concernant l'effet concurrentiel réel de leur fusion, il existe une incitation à utiliser de manière stratégique cette information privée pour pouvoir éviter des mesures correctives qui leur seraient coûteuses.

D'un côté, ceci renvoie à l'opportunité de mettre en évidence des mécanismes de révélation qui permettrait d'extraire l'information privée des partenaires, de manière à assurer un meilleur cadre d'application des mesures correctives. Le chapitre 6 de cette thèse identifie et étudie un tel mécanisme de révélation.

De l'autre côté, il convient d'explorer davantage les conséquences de l'application des remèdes des fusions en termes d'incitations. Par exemple, il est important de réaliser que l'acheteur, aussi bien que le vendeur des actifs transférés n'ont pas réellement d'intérêt à retrouver une concurrence accrue sur le marché post-fusion (Farrell (2003)). De plus, de tels transferts obligatoires d'actifs contribuent à atténuer l'effet de passager clandestin dont bénéficient généralement les rivaux d'une entité fusionnée, en transférant une part de leur richesse vers les participants à la fusion (voir Fridolfsson et Stennek (2005,a)). Par conséquent, les mesures correctives peuvent encourager des fusions à avoir lieu. Ces concentrations, qui plus est, ne seront pas nécessairement concurrentielles, compte tenu

du fait que les mesures correctives signalent un contrôle des concentrations moins strict, puisque l'autorité de la concurrence préfère modifier plutôt qu'interdire les fusions problématiques (voir Neven et al. (1993) et Seldeslachts et al. (2006)). Le chapitre 5 de cette thèse se propose d'ailleurs de contribuer à l'analyse économique des mesures correctives sur la base d'un cadre formel où leurs effets incitatifs sont explicitement pris en compte.

Pour résumer, ce quatrième chapitre passé en revue de manière synthétique les contributions théoriques analysant les procédures de prise en compte des gains d'efficacité potentiels et l'application de mesures correctives dans le cadre du processus de contrôle des concentrations. Ce faisant, ce chapitre a présenté la problématique des analyses originales proposées dans les chapitres 5 et 6, à savoir l'étude de l'interaction stratégique entre les autorités de concurrence et les entreprises qui fusionnent.

Chapitre 5[23]

Suivant l'analyse de Williamson (1968), qui a formalisé l'arbitrage entre l'inefficacité allocative d'une fusion horizontale et son éventuelle efficacité productive, la prise en compte des gains d'efficacité potentiels d'une concentration pour son bilan concurrentiel n'a cessé de gagner en importance, en confirmation du fait que les possibles réductions de coût peuvent profiter aux consommateurs et contribuer à l'amélioration du bien-être global. Néanmoins, le fait que la pratique du contrôle des concentrations suive ainsi des recommandations théoriques s'accompagne de l'appréhension que la politique de la concurrence devient (trop) laxiste envers les opérations de concentrations, compte tenu de l'information privée dont disposent les entreprises qui fusionnent quant à l'effet concurrentiel réel de leur concentration.

Pour limiter le risque qui en découle d'accepter à tort des fusions anti-concurrentielles, les autorités de la concurrence font largement appel à l'utilisation de mesures correctives (plus qu'à des interdictions catégoriques), qui sont destinées à réduire le pouvoir de marché des partenaires qui fusionnent et donc à restaurer la concurrence sur le marché post-fusion à un niveau comparable à celui d'avant.

Le point essentiel réside pourtant dans le caractère particulier du contrôle des concentrations, en tant que branche de la politique de la concurrence qui, au contraire de

[23] Issu de la collaboration avec Jean-Philippe Tropéano.

la répression des cartels ou des abus de position dominante par exemple, doit anticiper les conséquences d'un changement de la structure de marché (la fusion) avant même que celui-ci ait lieu, et aussi corriger ex-ante ses éventuels effets négatifs à travers la mise en place de mesures correctives (Motta (2004)). Par définition donc, le contrôle des concentrations se retrouve soumis à des erreurs de type I et II, qui font que le vrai défi pour les autorités de la concurrence est d'en minimiser les conséquences.

Ce chapitre étudie le profile optimal du contrôle des concentrations du point de vue précisément du besoin de limiter l'incidence des deux types d'erreurs. L'analyse formelle que l'on propose cherche à d'identifier la combinaison optimale entre la prise en compte des gains d'efficacité de la concentration pour son bilan concurrentiel et l'application des mesures correctives, dans un cadre où les deux types d'erreur sont possibles en raison de l'information privée des partenaires. En plus de la modélisation du contrôle des concentrations en situation d'asymétrie d'information, ce chapitre se propose de souligner les effets incitatifs des procédures du contrôle des concentrations, qui devraient être davantage pris en considération lors du bilan de l'action des autorités de la concurrence.

Il convient en effet de tenir compte du fait que sans la reconnaissance des gains d'efficacité potentiels, les entreprises ont moins d'incitations à rechercher des projets de fusion qui génèrent de tels gains. En réalité, planifier et matérialiser l'intégration de deux entreprises est coûteuse, et d'autant plus que les partenaires chercheraient la manière la plus efficace d'y parvenir. Par conséquent, sans cette incitation à un effort de planification, les autorités de la concurrence risquent d'aggraver le coût social des erreurs du contrôle des concentrations.

En mettant en évidence cet effet incitatif ex-ante de la prise en compte des gains d'efficacité lors du bilan concurrentiel d'une concentration, notre analyse insiste sur le fait que la hausse des coûts de procédure que ce bilan plus complet impose aux autorités de la concurrence n'est pas le seul aspect à considérer pour conclure sur la rationalité de la démarche (voir de ce point de vue l'analyse de Lagerlöff et Heidhues (2005)). De plus, ce chapitre suggère que la manière dont la prise en compte des gains d'efficacité sera réalisée est tout aussi importante, étant donné l'utilisation généralisée des mesures correctives.

En effet, l'acceptation de certaines concentrations sous conditions ne peut qu'élargir

l'ensemble des fusions compatibles avec les critères établis par les autorités de la concurrence. Mais en termes d'incitations ex-ante ainsi fournies aux entreprises qui envisagent la possibilité de s'engager dans des opérations de concentrations, ceci signale un contrôle des concentrations moins sévère, puisqu'au pire, les partenaires devront s'accommoder d'une mesure corrective et non pas d'une interdiction de leur fusion (Seldeslachts et al. (2006)). Le cas contraire est tout aussi envisageable (Farrell (2003)), puisque le coût privé des mesures correctives pour les partenaires pourraient les dissuader de rechercher des projets de fusions plus efficaces, car leur bénéfice privé en serait réduit.

Au-delà de la formalisation cohérente tous ses aspects incitatifs du contrôle des concentrations dans un cadre d'asymétrie d'information, l'analyse que l'on propose dans ce chapitre se distingue des autres contributions théoriques qui traitent du contrôle des concentrations, par l'étude explicite de l'interaction du point de vue incitatif entre la prise en compte des gains d'efficacité et l'application des mesures correctives.

En effet, le nombre et les caractéristiques des projets de fusions qui sont soumis pour examination aux autorités de la concurrence sont influencés par la sévérité de celui-ci, comme l'ont signalé Neven et al. (1993), Aaronson (1992), Besanko et Spulber (1993) ou Seldeslachts et al. (2006).

Par exemple, et de manière moins intuitive, Persson (2004) montre qu'un contrôle des concentrations plus stricte augmente les incitations de prédation sur le marché, alors qu'Ecer (2005) signale que les entreprises réagissent à un durcissement de la politique de la concurrence en développant des stratégies leur permettant de le contourner, de manière à pouvoir provoquer une hausse du prix post-fusion malgré l'action des autorités de la concurrence.

En même temps, malgré le signal de réglementation plus permissive envoyé par l'application des mesures correctives, celles-ci donnent l'occasion aux autorités de la concurrence de modifier implicitement la structure de marché, ce qui peut décourager la planification plus efficace des projets de fusion.

Le point de départ de notre formalisation est la caractérisation des gains d'efficacité potentiels générés par une fusion. En effet, ces gains d'efficacité ne peuvent se matérialiser qu'une fois la concentration elle-même a eu lieu, mais notre hypothèse centrale est qu'ils

sont aussi le résultat d'un effort ex-ante de planification de la part des partenaires[24], qui leur est coûteux et dont l'aboutissement n'est pas certain.

On considère de plus que les firmes qui fusionnent sont les seules à connaître le résultat de cet effort (s'il a été entrepris) au moment où le projet de fusion est soumis à l'autorité de la concurrence.

De plus, celle-ci n'observera qu'un signal public (et binaire) mais imparfait sur le résultat de l'effort (si effort il y a). Dans ce cadre avec asymétrie d'information, la formalisation retenue pour la prise en compte des gains d'efficacité sera que l'autorité de la concurrence s'engage à accepter une fusion dont les partenaires font valoir des arguments d'efficacité seulement si le signal public indique l'existence de tels gains. Ceci revient à modéliser un contrôle des concentrations soumis aux deux types d'erreurs, puisqu'un "bon" signal peut conduire à l'acceptation à tort des fusions, tandis qu'un "mauvais" signal peut justifier le rejet à tort des fusions.

Une autre règle de décision possible pour l'autorité de la concurrence est d'accepter toute concentration pour laquelle les participants ont proposé des mesures correctives. Notre hypothèse est que les remèdes proposés sont efficaces, donc tout risque de fusion anti-concurrentielle devient nul, mais en même temps les partenaires subissent un coût privé qui élimine complètement l'incitation à réaliser l'effort coûteux de planification ex-ante. En d'autres termes, l'acceptation des fusions avec mesures correctives assurent que le critère de bien-être retenu par l'autorité de concurrence sera satisfait[25], mais au coût d'une moindre incitation à entreprendre des fusions plus efficaces.

Dans ce cadre, la première étape de notre analyse est de déterminer le mécanisme justifiant la prise en compte des gains d'efficacité pour la décision d'accepter ou non une fusion. Cela arrive seulement pour une qualité suffisante du signal observé par l'autorité de la concurrence. L'intuition est que la prise en compte des gains d'efficacité est justifiée par le choix des partenaires à entreprendre l'effort coûteux de planification ex-ante (qui dépend lui-même de la qualité suffisante du signal), mais aussi par le fait que du point de

[24] Voir aussi Fabrizi et Lippert (2005) et Cabolis et al. (2005) pour d'autres modélisations de concentration avec gains d'efficacité endogènes.

[25] Quel qu'il soit, surplus des consommateurs ou bien-être total, notre analyse qualitative est robuste au choix de critère de bien-être.

vue du critère de bien-être retenu, cet effort conduit en espérance à un niveau plus élevé de surplus par rapport à la situation initiale. En d'autres termes, l'engagement de l'autorité de contrôle est rationnel tant que le coût en bien-être des deux types d'erreur de jugement possibles n'est pas trop élevé. Ceci permet une interprétation équivalente, à savoir que l'opportunité de la prise en compte des gains d'efficacité pour accepter ou non une fusion résulte d'un arbitrage entre l'incitation fournie aux entreprises à proposer des concentrations plus efficaces, et le risque d'acceptation à tort des fusion anti-concurrentielles, compte tenu de l'information asymétrique dont dispose l'autorité de la concurrence.

L'étape suivante de notre analyse consiste à évaluer l'opportunité de la prise en compte des gains d'efficacité lorsque les entreprises ont la possibilité de proposer elles-mêmes des mesures correctives comme partie de leur projet de fusion. Ceci nous permettra d'étudier la combinaison optimale entre ces deux procédures du contrôle des concentrations.

2tant donné qu'une fusion sera acceptée soit parce que le "bon" signal a été observé, soit parce que les partenaires ont proposé dès le départ des mesures correctives, on montre que l'application de celles-ci modifie l'arbitrage mis en évidence auparavant.

D'un côté, les mesures correctives diminuent l'incitation à l'effort ex-ante fournie par la prise en compte des gains d'efficacité, puisqu'elles réduisent le coût d'opportunité de faire valoir cet argument pour faire acceptér la fusion. En effet, au lieu de risquer de voir leur projet rejeté, les partenaires peuvent toujours en proposer un moins efficace mais moins coûteux, assorti de mesures correctives, ce qui garantit son acceptation. De l'autre côté, du point de vue de l'autorité de concurrence les mesures correctives présentent l'avantage d'éliminer complètement le risque d'accepter à tort une fusion anti-concurrentielle.

Finalement, du point de vue des entreprises qui fusionnent, la possibilité d'avoir recours ou non à des mesures correctives lors de la soumission de leur projet de concentration leur permet de signaler les caractéristiques de leur fusion. En effet, on montre qu'en fonction de la qualité du signal, les partenaires ayant réussi leur effort de planification peuvent avoir intérêt à se signaler en ne proposant pas de mesures correctives avec leur projet de fusion, tandis que les partenaires dont l'effort a échoué peuvent également le signaler en proposant des mesures correctives[26]. En d'autres termes, celles-ci présentent pour

[26] Intuitivement, une meilleure qualité du signal augmente les chances pour une fusion efficace d'être

l'autorité de la concurrence l'avantage supplémentaire de permettre un allègement de sa contrainte informationnelle.

Par conséquent, si le bénéfice attendu d'une fusion plus efficace est très important, il est préférable de privilégier l'effet incitatif de la prise en compte des gains d'efficacité, et donc de renoncer à l'application simultanée des mesures correctives. Par contre, si le coût social d'accepter à tort une fusion est très élevé, il devient plus important de se prémunir contre cette possibilité, et par conséquent la prise en compte des gains d'efficacité devra toujours s'accompagner de l'application de mesures correctives.

Ainsi, on identifie la combinaison optimale des deux procédures compte tenu de l'ampleur relative des deux types d'erreurs possible dans le cadre d'un contrôle des concentrations en situation d'asymétrie d'information.

De plus, ce résultat s'ajoute à la discussion de l'opportunité pour le Règlement CE de janvier 2004 d'imoser la prise en compte les gains d'efficacité potentiels pour le bilan concurrentiel des concentrations, en raison des coûts engendrés par les problèmes informationnels. Notre analyse rappelle la pertinence de la prise en compte des effets incitatifs du contrôle des concentrations, qui ne devrait pas être négligés, compte tenu de l'interaction réciproque entre la politique de la concurrence et le comportement des agents économiques.

Chapitre 6[27]

L'objectif du modèle développé dans ce chapitre est de contribuer à l'analyse économique des mesures correctives en considérant le rôle des gains d'efficacité potentiels pour la détermination des mesures correctives optimales.

Plus précisément, on formalise le lien entre le niveau de gains d'efficacité générés par la fusion et l'ampleur du transfert d'actifs qui sera nécessaire pour rendre la fusion compatible avec l'objectif de l'autorité de la concurrence, à savoir d'empêcher toute hausse du prix post-fusion. En pratique, l'application des mesures correctives doit obéir à un tel objectif de proportionnalité par rapport au dommage concurrentiel causé par la concentration, puisque il est recommandé que les mesures correctives soient telles que ce dommage soit

correctement reconnue comme telle, ce qui explique ces incitations contraires pour les partenaires ayant réussi ou non l'effort coûteux de planification ex-ante.

[27] Issu de la collaboration avec Jean-Philippe Tropéano.

complètement réparé, mais que leur intervention distorssive sur la structure de marché ne soit pas excessive. Selon le Règlement Européen de 2004 relatif au contrôle des concentrations, "Ces engagements devraient être proportionnels au problème de concurrence et le résoudre entièrement" (paragraphe 30).

Par conséquent, et compte tenu de cet objectif de proportionnalité, les autorités de la concurrence devraient exiger des mesures correctives plus substantielles de la part des projets de fusions moins concurrentielles, et au contraire, accepter des concentrations peu problématiques sous peu de conditions. Il convient donc de remarquer que pour pouvoir envisager des mesures correctives optimales, les autorités de la concurrence ont besoin de connaître les gains d'efficacité potentiels de la concentration, ce qui est vraisemblablement une information privée des entreprises qui fusionnent (Yao et Dahdouh (1993)).

Ainsi, le second objectif de l'analyse de ce chapitre est d'identifier un moyen d'extraire cette information privée afin de permettre l'application de mesures correctives adaptées au dommage concurrentiel effectif de la concentration.

Un tel mécanisme de révélation serait incontestablement utile aux autorités de concurrence, compte tenu de l'asymétrie d'information dans laquelle se déroule le contrôle des concentrations. Röller et al. (2001) suggéraient ainsi la possibilité d'utiliser des vraies licences à fusionner, qui donneraient ce droit aux partenaires potentiels en échange d'un transfert monétaire vers le budget de l'Etat, mais une telle procédure reste purement théorique pour l'instant.

Le mécanisme de révélation que l'on propose de considérer dans ce chapitre n'implique pas de paiement vers l'autorité de contrôle, même si le principe de base est toujours celui d'une taxe ou d'une licence à fusionner. Notre proposition repose sur la combinaison d'un transfert d'actifs et d'un certain prix de vente obtenu en retour de la part de l'acheteur des actifs, ce qui revient à implémenter une vente réglementée d'actifs. Ceci renvoie à l'opportunité d'utiliser les mesures correctives comme moyen d'extraire l'information privée qui est pertinente pour leur détermination optimale. Malgré la réticence actuelle des autorités de concurrence à s'impliquer dans la fixation du prix de vente des transferts d'actifs requis comme mesure corrective, notre analyse signale plutôt l'intérêt qu'il y a à exploiter toute l'information pertinente, à savoir celle qui est transmise par le prix du

transfert d'actifs lors de la négociation entre le vendeur et l'acheteur.

En effet, notre analyse permet d'aboutir à cette interprétation en termes de signal, puisque les entreprises qui participent à une fusion plus efficace pourront transférer moins d'actifs, mains en échange d'un prix de vente réduit, ce qui les distingue des partenaires à une fusion moins efficace, qui auront intérêt au contraire de récupérer le prix maximum pour un transfert d'actifs plus substantiel[28].

Bien que la littérature économique ait reconnu les conséquences de la contrainte informationnelle qui pèse sur le contrôle des concentrations, il n'y a pas beaucoup de propositions de modalités pour extraire l'information privée des entreprises qui fusionnent. Faulli-Oller et Corchon (1999) montrent que implémentation en stratégies dominantes des fusions pro-concurentielles n'est possible que sous des conditions très restrictives, et de plus, leur analyse ne prend pas en compte la possibilité d'avoir recours à des mesures correctives.

Celles-ci n'ont été que récemment considérées comme instrument de révélation, suivant la remarque de Rey (2000) d'utiliser les transferts ou les quasi-transferts pour résoudre l'asymétrie d'information. Gonzalez (2003) et puis Féral (2006) ont suivi cette remarque, mais à la différence de ces contributions, notre mécanisme de révélation est à la fois efficace du point de vue de l'extraction de l'information mais aussi non distorssif, autrement dit il permet d'implémenter des mesures correctives proportionnelles au dommage concurrentiel de la concentration.

Il convient de remarquer à cet égard que notre formalisation se distingue non seulement par le choix particulier de l'instrument de révélation secondaire, le prix de vente des actifs, mais aussi par le cadre de formalisation retenu, fondé sur les contraintes de capacité. Celui-ci nous permet d'étudier l'impact des mesures correctives sur les contraintes de capacité des entreprises qui fusionnent ou de leurs rivaux. Ce faisant, ce chapitre insiste sur la condition nécessaire pour que des mesures correctives structurelles s'avèrent efficaces, à

[28] La fusion avortée entre Staples et Office Depot semble exemplifier une telle situation, puisque Staples avait proposé de renoncer à 140 millions de dollars lors de la cession d'actifs vers le rival Office Max exigée comme mesure corrective, pour montrer à quel point la fusion avec Office Depot serait bénéfique et pro-concurrentielle. Pourtant, ce signal envoyé en direction de la Federal Trade Commission américaine n'a pas été bien reçu, la fusion étant finalement interdite par l'intervention d'une Court de justice. (Source : le Washington Post du 13 mars 1997.)

savoir que l'acheteur des actifs transférés les utilise réellement. En d'autres termes, il faut que les actifs cédés servent à desserrer sa contrainte de capacité, autrement l'acheteur se retrouvera avec une capacité excédentaire oisive dont il profitera pour maintenir un prix élevé sur le marché post-fusion[29].

Plus préciséement, dans un triopole symétrique de Cournot avec contraintes de capacité, on considère une fusion bilatérale exogène qui peut générer des réductions de coût grâce à des gains d'efficacité obtenus par les partenaires. Pourtant, si la réduction de coût est faible, elle n'empêchera pas la contraction de la production jointe des partenaires post-fusion, car une partie de la capacité totale sera inutilisée. Dans ce cas, l'autorité de la concurrence exigera un transfert d'actifs vers le rival restant sur le marché, de manière à resserrer la contrainte des capacité des partenaires et à diriger l'industrie vers un équilibre post-fusion sans capacité oisive, ce qui assure dans ce cadre que le prix n'augmentera pas.

La première étape de notre analyse est d'identifier le transfert d'actifs optimal, qui permettra de garder le prix constant. On montre que cette mesure corrective dépend du montant de la réduction de coût obtenue par les partenaires, donc de leurs gains d'efficacité. Plus précisément, une entreprise fusionnée moins efficace devra transférer plus d'actifs qu'une autre dont le coût marginal est inférieur, car une réduction de coût plus faible génère plus de capacité oisive qui devra être transférée à la firme rivale pour garder le prix constant sur le marché.

Pour résumer, la situation de référence avec information symétrique entre les entreprises qui fusionnent et l'autorité de la concurrence permet de retrouver le principe de proportionnalité entre la cession d'actifs et le dommage concurrentiel de la fusion.

L'étape suivante de notre analyse est d'étudier le cas de l'information asymétrique. Il convient de remarquer ici que l'information privée des partenaires concernant les gains d'efficacité réels de leur fusion les incite à l'exploiter de manière stratégique, afin de pouvoir éviter une cession d'actifs plus grande qui serait exigée par l'autorité de contrôle. En effet,

[29] Les conséquences des transferts d'actifs entre des entreprises rivales ont fait l'objet d'autres contributions théoriques. Farrell et Shapiro (1990,b) ont ainsi examiné les conséquences sur les profits de l'industrie et le bien-être global, alors que Compte et al. (2002) et Vasconcelos (2005,a) ont pu montrer que les cessions d'actifs comme mesures correctives peuvent encourager la collusion sur le marché post-fusion (en rendant plus symétrique la distribution des parts de marché entre les concurrents).

le transfert d'actifs représente un coût pour les partenaires, en réduisant leur capacité et profit post-fusion. Par conséquent, on peut montrer que seul, le transfert d'actifs de premier rang (avec information symétrique) ne permettra pas de garder constant le prix en cas d'asymétrie d'information. En résumé, un instrument supplémentaire sera nécessaire pour extraire l'information privée.

Ce deuxième instrument que l'on associera au transfert d'actifs dans un mécanisme de révélation inspiré de la théorie des contrats sera le prix de vente des actifs. Formellement, l'asymétrie d'information rend nécessaires des contraintes d'incitation, spécifiant le prix de vente pour le transfert d'actifs destiné à chaque type d'entreprise fusionnée, en fonction donc de sa réduction de coût.

Il convient de noter pourtant qu'en utilisant cet instrument supplémentaire de révélation, on se distingue du cadre standard principal-agent, puisque ce prix de vente n'est pas un paiement des entreprises vert l'autorité de contrôle, mais un transfert forfaitaire entre des firmes rivales. En évitant l'implication de l'autorité de la concurrence en tant que « régulateur », on évite également de modifier le profit total de l'industrie, puisque seule sa distribution interne change. De manière équivalente, l'utilisation d'un tel instrument conduit à réconcilier les intérêts divergents des entreprises qui fusionnent et leurs rivaux en ce qui concerne les réductions de coût obtenues par la fusion, pour ainsi assurer la participation de l'acheteur et du vendeur des actifs au partage du profit total.

Pour aboutir à l'objectif de révélation de l'information privée, notre analyse met d'abord en évidence la condition de "single crossing" qui permet de séparer les entités fusionnées en fonction de leurs réductions de coût. Cette condition indique que les partenaires à une fusion plus efficace profitent davantage de leur capacité jointe que ceux d'une fusion moins efficace, car leur réduction de coût plus substantielle leur permet d'atteindre un profit supérieur avec une même capacité totale que les autres. Par conséquent, un même transfert d'actifs sera plus coûteux pour les partenaires plus efficaces, et donc leur disponibilité à céder des actifs sera plus faible, tout comme leur disponibilité à recevoir de l'argent en retour.

Cette condition permet d'aboutir au résultat suivant. Le menu de contrats proposé aux deux types d'entreprises fusionnées que l'on considère comprendra un transfert d'actifs

réduit en échange d'un prix de vente plus faible, tandis que le prix de vente du transfert d'actifs plus grand correspondra à la disponibilité maximale à payer de l'acheteur. Compte tenu de la condition d'intersection unique, les partenaires plus efficaces choisiront le premier contrat de cession d'actifs, alors que les partenaires moins efficaces choisiront le second.

Puisque ce menu de contrats permet de retrouver les transferts d'actifs optimaux de premier rang, il est efficace. De plus, seuls les prix de vente peuvent être distordus, mais cet instrument n'est pas coûteux pour l'autorité de la concurrence en tant que "principal" et pour l'objectif de prix constant. Ce mécanisme est donc également peu distorsif.

Il convient de remarquer que ce menu de contrats revient à implémenter une licence à fusionner avec un prix moyen non linéaire. Surtout, il faut souligner que le "paiement" ne se réalise pas vers l'autorité de la concurrence. Plus précisément, la "licence" à fusionner consiste soit en l'acceptation d'un transfert d'actifs plus grand pour un prix de vente maximum, soit en l'acceptation d'un prix de vente inférieur à la disponibilité à payer de l'acheteur, mais pour un transfert d'actifs réduit.

Cela suggère qu'en pratique, même sans intervenir dans la négociation qui aboutit au prix de vente des actifs transférés, l'autorité de la concurrence peut extraire de l'information de la combinaison cession d'actifs – prix de vente sur laquelle le vendeur et l'acheteur tombent d'accord.

De plus, l'analyse proposée dans ce chapitre relève aussi du choix optimal des instruments à utiliser pour contrôler les effets anti-concurrentiels des concentrations, compte tenu de la contrainte informationnelle spécifique. Alors que la fixation des prix représente habituellement une distorsion importante, dans le contexte du contrôle des concentrations le prix de vente des actifs comme instrument de révélation de l'information privée s'avère moins distorsif que le transfert d'actif lui-même, car il ne modifie pas la structure de marché, ni les choix de production des entreprises.

Conclusion

Pour résumer, l'objectif de cette thèse était de contribuer à l'analyse théorique des motivations, des conséquences et des réponses réglementaires relatives aux concentrations

horizontales. D'abord, notre analyse a mis en évidence l'importance de la prise en compte du comportement post-fusion pour l'analyse positive des concentrations, que ce soit dans le sens d'un repositionnement (spatial ou dans la gamme des produits), ou dans le sens d'une gestion centralisée ou pas de l'entreprise fusionnée. Ceci reste pertinent du point de vue normatif, puisque le comportement tout autant que la nouvelle structure de marché préoccupe les autorités de concurrence. Mais compte tenu des contraintes informationnelles et incitatives spécifiques au contrôle des concentrations, il paraît souhaitable d'élargir la boîte à outils des autorités de concurrence.

GENERAL INTRODUCTION

CLOSE -UP ON MERGERS...

On June 30, 2006, the Financial Times estimated in one of its articles ("M&As fever surpasses dotcom era") that merger and acquisition (M&A) activity worldwide was set to reach $1,930bn for the first half of the year 2006, marking the highest half-year volume on record and surpassing even the days of the dotcom boom, despite the expectations of many who thought that they never would again reach the record 2000-2001 levels.

Merger and acquisitions are known to be contagious. The past century witnessed several great merger waves - after the one at its beginning, other occurred at the ends of the 20s, 60s, 80s and 90s. Although the earlier waves were rather confined to the US and UK, the most recent ones qualified as global, and according to some[30], the current biggest acquisition panic is actually happening in Continental Europe. This is most visible for the European energy industry, which is currently consolidating at a rapid pace. Since the beginning of the year 2006, the Spanish company Gas Natural made a $26 billion hostile bid for the Spanish utility company Endesa, in an attempt to combine the no1 electric and gas companies in Spain. Then, in reaction, the German E.On soon made a $35 billion offer for Endesa, which, if successful, would make the world's largest utility company. Then Italy's Enel SpA (no1 electrical supplier in Italy) announced it was considering making a hostile bid for the French utility Suez SA, which owns electricity, gas, water, and waste

[30] See Oligopoly Watch dated February 26, 2006.

assets. Almost immediately, the French government announced that Suez and gas utility Gaz de France would merge.

In general, merger waves occur in response to some type of shock, such as a new production technology, a new organizational advance or new form of corporate governance, industry deregulation or privatization, as well as changes in the merger policy (more or less restrictive). For instance, the megamergers in media, banking and finance or entertainment in the late 90s reflect both the deregulation shock (Mitchell and Mulherin (1996)) as well as the technology shock of the digital revolution (Andrade et al. (2001)).

...AND THEIR CONSEQUENCES

If the fact that mergers tend to come in waves represents a stylized fact, so do some confirmed conclusions on merger performance and market effects. In short, the profitable acquisitions are not too frequent (see Ravenscraft and Scherer (1987) for one of the earliest, but far-reaching, analyses, or Tichy (2001) for a summary of about 80 empirical merger studies). Actually, based on an international comparison, Gugler et al. (2003) find that at best half of acquisitions appear to increase profits for the partners, with great variability in overall merger performance. One can easily recall famous 'disastrous' M&As, including AOL-Time-Warner, Chrysler and Daimler Benz, and HP with Compaq, consistent with the remark that "Big Mergers Have a Long History of Failure and Trouble" (see the New York Times, January 15, 2004), yet other big deals have done fine, like Verizon and Comcast, or Mobil and Exxon.

In addition, it appears that about half of these profitable mergers are contractionary in terms of output, so they increase prices, as a result of which consumers actually benefit from no more than a quarter of the mergers. Consider the following example[31] (by no means unique) on the various bank mergers and acquisitions which took place in the US between 2000 and 2006. In January 2004, no4 Chase/JPMorgan acquired no3 Bank One, to become no2 right behind Citigroup. In July 2005, no5 BOA bought no2 MBNA to become the top credit-card company, with Citigroup becoming no2 and Chase/Bank One becoming no3. Basically, the top 6 merged into the top 3 in 6 years or less, with a

[31] Source: Latefee Avoidance website by attorney Carl E. Person, available at http://www.lawmall.com/latefees/marketshare/php

total market share apparently between 65% and 70% by now. Yet, evidence shows "that increased concentration in the banking industry has not benefitted bank customers.[...] In addition, large interbank mergers reduce competition in ATM network markets as well as in credit card markets.[...] Larger banks charge higher fees,[...] and bank mergers have an adverse effect on consumer deposit pricing"[32].

In the words of (and based on the regressions of) Gugler et al. (2003), "if one categorizes mergers that increase market power, or that reduce efficiency, as welfare reducing, then a majority of the mergers taking place around the world over the last 15 years appear to be welfare reducing".

This is consequential. The fact that unprofitable mergers occur may be costly for shareholders, but the fact that they reduce welfare, mostly by increasing prices, is no trifling matter for consumers in general. If the (un)profitability is to be explained, the role of competition authorities controlling mergers and of merger policy in general needs to be accounted for as well.

CLOSE-UP ON MERGER POLICY

Merger control is important because by means of prohibitions or corrective measures it can prevent the creation of anti-competitive market structures, besides deterring anti-competitive mergers from forming in the first place. At least, this is the purpose and desired outcome of merger control, if effective, but this is not always the case.

Based on a sample of 100 mergers reviewed in Europe according to the European Community Merger Regulation, Neven and Röller (2002) establish a rather low frequency of type I errors, i.e. pro-competitive mergers that were prohibited by the European Commission, but a rather high frequency of type II errors, i.e. situations where the Commission failed to block or to remedy anti-competitive mergers. In their turn, based on a sample of 164 EU merger control decisions, Duso et al. (2003) equally study whether the EU merger procedures are prone to systematic errors, and find type I errors in 28% of cases

[32] Testimony of Craig Collette at the Hearing of the Federal Reserve Bank of San Francisco on Planned Merger of Nationsbank and Bank of America, July 10, 1998 - available at http://www.federalreserve.gov/events/publicmeeting/19980709/Panel19.pdf

and type II errors in 23% of them. As far as the US merger policy is concerned, the Federal Trade Commission published in 1999 a study[33] examining the outcome of structural merger remedies, i.e. asset divestitures, ordered from 1990 to 1994 for the explicit purpose of preventing the anti-competitive effects of mergers identified as welfare-reducing. The study concluded that about three quarters of divestitures had succeeded in creating viable operations in the relevant market, and that both parties involved in the asset transfer transaction acted according to their own respective interests, quite different from those of the competition authority. In other words, it obtained that about 25% of applied remedies did not achieve relief for the competitive concerns raised by the merger, that firms behave strategically, and that the Federal Trade Commission had not been able to prevent the failure of these remedial measures, since the incriminated divestitures had been approved. A similar study was published in 2005 by the European Commission's Directorate General Competition (EC DG Comp Remedy Study[34]), with a similar reported outcome: in only 57% of merger cases the requested remedies could undoubtedly be considered effective.

THE RESEARCH PROJECT OF THE DISSERTATION

Such stylized facts raise questions for the economic research: why do mergers fail to increase profits or welfare? And since they do, why are they so many to take place? And what should the merger policy do about it, and moreover what can it really do? The rationale, market consequences and antitrust treatment of mergers represent topical issues for economic research. The essays in this dissertation aim to provide further insight into these questions, from a purely theoretical point of view. *The first part of the thesis will examine the individual private incentives to merge and some of the welfare consequences of such a decision. The second part of the dissertation will focus instead on the strategic interaction between the merging firms and the competition authorities so as to draw inference on the design of merger control.*

The type of merger on which antitrust agencies focus because most likely to raise competition problems, and the type of merger which this dissertation will exclusively

[33] Available at www.ftc.gov/os/1999/08/divestiture.pdf

[34] Available at www.europa.eu.int/comm/competition/mergers/others/remedies_study.pdf

concentrate on, is a merger between firms engaged in directly competing activities. These mergers are classified as horizontal mergers, and account for a substantial bulk of mergers qualifying for review by the competition authorities. For instance, in the 1999 report "Merger appraisal in oligopolistic markets" prepared for the UK Office of Fair Trading, horizontal concentrations accounted for 93% of all mergers and acquisitions reviewed (97% by value), with diversifying mergers accounting for 5% (2%) and vertical mergers for just 2% (1%).

Horizontal mergers may threaten competition by eliminating the direct competitive constraints which each of the merging parties formerly placed on each other. Actually, "whether firms compete in prices or quantities (or capacities), a merger between competitors increases the remaining firms' market power (both for the merged firm and its competitors), thereby leading (absent any efficiency gains) to higher prices and lower output"[35]. Along with the unilateral market power increase, a merger may also threaten competition if it creates an environment in which tacit or explicit collusion between those firms left in the market becomes more likely[36].

In this thesis we are going to overlook this co-ordinated effect of a merger, and only concentrate on the consequences of and the antitrust response to unilateral market power increases. By so doing, we aim to further explore the individual incentives to merge, independent from the possibility of subsequent profitable collusive behaviour. Moreover, this enables us to build our different analyses, both positive and normative, around the topic of merger efficiencies, which are now recognized as an important positive, although most often than not uncertain, unilateral effect of concentrations. The impact of resulting cost savings on market power, on welfare and even on coordinated behaviour has already been pointed out in the literature. Basically, "economics strongly suggests that efficiencys avings should be at the centre of the analysis of mergers (Motta (2004, p.271)), so the relevance of merger efficiency gains for the outcome of a merger is now explicitly recognized

[35] See "The Economics of Unilateral Effects", M. Ivaldi, B. Jullien, P. Rey, P. Seabright and J. Tirole, Interim Report for DG Competition, European Commission, 2003, available at http://ec.europa.eu/comm/competition/mergers/review/the_economics_of_unilateral_effects_en.pdf

[36] The impact of a reduced number of competitors is essential - see Selten's (1973) "Four are few and six are many".

in legal texts - in the wording of the 2004 EC Merger Regulation (paragraph 29), "In order to determine the impact of a concentration on competition [in the common market], it is appropriate to take account of any substantiated and likely efficiencies put forward by the undertakings concerned. It is possible that the efficiencies brought about by the concentration counteract the effects on competition, and in particular the potential harm to consumers".

Furthermore, in terms of antitrust response, the unilateral competition concern are often (to be) solved by merger remedies rather than downright prohibitions, and we are going to focus on merger remedies as a merger control instrument in this dissertation. We do so because competition authorities extensively rely on merger remedies to regulate mergers. In the US, remedies constituted only 23% of US merger policy actions in the late 1980s, but by the year 2000, remedies were employed in over 60% of US merger cases requiring antitrust action (Parker and Balto (2000)). In addition, "unlike the issues related to assessment of a merger's competitive effects, the lack of transparency on the theory of remedies as well as the extraordinarily rare judicial oversight of remedies leaves the issue of remedies as one where the antitrust agencies possess considerable discretion", as noted by the 1999 report "Merger appraisal in oligopolistic markets" prepared for the UK Office of Fair Trading. Indeed, despite increased reliance of merger laws on economic theory principles[37], "the fashioning of merger remedies is [yet] subject to standards that are not well-defined or consistent" (Blumenthal (2001)), so further theoretical insight into their consequences and optimal application cannot be redundant. Economic research on merger remedies hardly needs further justification than the openly acknowledged interest competition authority show with this respect - in the words of Parker and Balto (2000), "Probably no single issue currently is receiving as much attention as the topic of relief in merger cases. The question of whether there is a remedy to an anticompetitive merger and what that remedy should be is perhaps the single most intriguing and complex issue faced by the Bureau of Competition of the Federal Trade Commission."

[37] As argued by the successive revisions (1992, 1997) of the US Merger Guidelines issued by the Federal Trade Commission and the US Department of Justice, as well as by the recent (2004) reform of he EC Merger Regulation, explicitly designed towards 'a more economic approach'.

Actually, our analysis of merger remedies will concentrate on structural remedies, i.e. asset transfers, also called divestitures, although certain conclusions we draw are more general. This is consistent with our choice to deal with horizontal market concentration, to the extent that the divestitures represent the preferred merger control instrument employed by antitrust authorities for such mergers. The 2005 Remedy Study of the European Commission DG Comp stresses that about 80% of the commitments required from the merging parties address horizontal concerns, and that divestitures account for more than 60% of all remedies. They are preferred to behavioral merger remedies, because they are final, and allow a one-shot interference with the market structure, since they change the allocation of property rights within the industry. As such, they implicitly alter the production decisions, and thereby the merger profitability and also the incentives to merge in the first place.

The research area of this thesis will thus be confined to the unilateral effects of and the remedies applied to the horizontal mergers.

Accounting for firms' strategies

*The **first part** of the dissertation will deal with both topics, but in a spatial framework and from a positive standpoint. More precisely, it proposes a spatial analysis of merger decisions and of their consequences by taking into account the firms' optimal location decisions following the merger.*

Space and location choice can refer to both geography and product range - to a greater or lesser extent, virtually all markets involve some element of spatial differentiation, either geographical or based on consumer preferences, so a merger analysis can only gain in realism by taking into account the spatial feature. The spatial framework can be useful for the positive analysis of mergers in order to examine the incentives to merge provided by particular location patterns or degrees of product differentiation, or to account for such merger consequences as product repositioning or geographical (re)shaping of a distribution network[38]. As the 1999 report for the UK Office of Fair Trading stresses, "mergers do not

[38] Berry and Waldfogel (2001) find increased product variety following horizontal market concentration in the US radio station industry, which they approximate by Hotelling's linear city.

take place in a vacuum...[but] cause structural change in the industry".

The first chapter will provide an introduction to the topic by reviewing the theoretical literature dealing with horizontal mergers in a spatial setting, with an intended focus on the two-way relationship between firms' locations (both in the geographical and product range sense) and their behaviour. For this purpose, we first explore the incentives conveyed by locations for firms' merger and merger-related strategies, then go on to address the impact of merger on location choices. By so doing, we illustrate to what extent the theoretical literature on horizontal mergers has exploited location and space in general for better seizing the motivations for and the outcome of horizontal market concentration.

Chapters 2 and 3 provide in their turn formal spatial analyses of horizontal mergers. The two models proposed share the same approach, which is to examine the incentives to merge by studying the strategies to which firms resort to make their merger (more) profitable. They also share the same underlying spatial framework, namely the shipping Cournot model of spatial price discrimination. As shown by the main findings from location theory reviewed in the first chapter, this setting is consistent with everyday observations of overlapping market areas for rival firms, as well as with the spatial clustering of rival firms or outlets (see Anderson and Neven (1991) and Pal and Sarkar (2002)). On the other hand, the combination between the homogenous product quantity competition and the shipping assumptions allows an easily tractable and practically relevant modelling of product differentiation, to the extent that the framework corresponds to the mechanism of flexible manufacturing described by Eaton and Schmitt (1994), where the basic product (standing for the location of the firm) is customized at a certain cost (here, the shipping cost) to better satisfy individual consumers preferences. Thus, by endogenizing post-merger location choices in this framework, we will be able to further assess the impact of product design changes and/or spatial relocation on merger profitability.

Chapter 2 focuses on the impact of location choice for merger profitability and as such contributes to the literature examining the profitability of horizontal mergers. Despite the recurrent merger waves, the theoretical studies comfort the previously quoted and empirical reports in their indication that often merging partners incur a profitability

loss, while the profits of non-merged rivals increase, which can eventually question the very incentives to merge (see Stigler (1950)). This latter part of the so-called merger profitability paradox heavily depends on the underlying assumptions on market competition - in short, the private rationality of horizontal mergers is much more debatable with quantity than with price competition (see Salant et al. (1983), Deneckere and Davidson (1985) and Gaudet and Salant (1992)). To restore Cournot merger profitability, cost savings or Stackelberg leadership for the merging firms have been shown to be effective in the non-spatial setting[39]. The spatial literature equally forwarded a solution to the paradox, by endogenizing the post-merger location choices of firms (Norman and Pepall (2000)[40]).

Chapter 2 in our dissertation basically checks the robustness of this solution. By examining post-merger location equilibria based on strictly the same assumptions, except for the space linearity, the second chapter of this dissertation checks the relevance of the intrinsic market characteristics for the (un)profitability result. More precisely, the analysis in Chapter 2 questions the sufficiency of the post-merger relocation assumption w.r.t. merger profitability by focusing on the homogenous-location circular market case. In other words, Chapter 2 verifies whether undertaking product design changes or outlet relocation to save on post-merger costs can ensure merger profitability in absence of some market asymmetry or niche to exploit. This incidentally comes down to checking the robustness of a corollary of Deneckere and Davidson (1985), according to which in markets with symmetric intensity of competition the incentives to profitably merge are considerably lower.

Besides its main purpose of profitability check, Chapter 2 equally contributes to the question of optimal location/product design choices of multi-store/product firms, such as typically result from mergers. In contrast with the linear case, for which location equilibria for multi-store firms have already been completely worked out (see Pal and Sarkar (2002)), this analysis is yet incomplete for the circular markets. We contribute by working out two particular cases. From a location theory viewpoint, they also enable us to check whether the multiplicity property of the circular market paradigm extends from

[39] See Szidarovsky and Yakovitz (1982) and Daughety (1990).

[40] Without post-merger optimal relocation, Norman and Pepall (1998) show that spatial Cournot horizontal mergers are subject to the same (un)profitability paradox.

single-plant competition to the multi-plant case.

Chapter 3 deals instead with the optimal horizontal integration strategy in a spatial model building on the linear city representation. Firms are generally thought to undertake acquisitions when it is *the most* profitable means of enhancing capacity, or obtaining new knowledge and skills, or entering new product or geographic areas, or reallocating assets into the control of the most effective managers (Pautler (2001)). However, Scheffman (1993) argues that decisions to merge are part of a broader strategic plan aimed to achieve some long-term goal. The empirical study by Mulherin and Boone (2000) obtains significant time clustering in both acquisitions and divestitures, which is consistent with the observation that mergers come in waves, but are followed by intensive industry restructuring by means of voluntary asset sales and spin-offs. Yet, non-spatial theoretical models obtain contrary incentives to merge and to divisionalize/spin-off, because the two strategies cannot be simultaneously profitable (see Salant et al. (1983), Polasky (1992), Baye et al. (1996)).

The purpose of Chapter 3 is to examine in a spatial setting the relationship between merger (in the sense of consolidation, joint operation) and de-acquisition (in the sense of divisionalization, spin-off). By considering a spatial model, we aim to provide a possible rationale for this sequence of business moves - Porter (1987) finds for instance that 50% of merged firms divest later on. This chapter checks whether post-merger de-acquisition (in the sense of divisionalization) can possibly improve merger profitability, by allowing for optimal location choices (and the ensuing cost savings) after both consolidation and de-acquisition. We also check whether this possible complementarity between the two business moves can hold when the merger itself is not profitable, which may suggest a motivation for apparently unprofitable mergers (just a step in a complex corporate strategy to raise profitability). *Basically, the analysis in this chapter questions the merger 'optimality', whatever its profitability, by considering the merger as part of a global corporate strategy including subsequent divisionalization.* If anything, this chapter suggests that the analysis of merger performance in isolation may be incomplete, since firms engage in complex growth strategies involving a wider range of restructuring beyond the simple horizontal

integration[41].

Furthermore, this profitability analysis of the merger-divisionalization strategy enables a discussion of the impact of divestitures for merger profitability, given that divisionalization or spin-off basically comes down to an asset transfer between firms. By identifying the mandatory divestiture equivalent to the profitable spin-off strategy we consider, we suggest the possibility for mergers, possibly unprofitable, to benefit from subsequent divestiture injunctions. This may cast some doubt on the generality of the assumption that merger remedies are costly for merger partners, and may also question whether the latter, when complying with mandatory divestiture injunctions, may be actually motivated by different incentives than the competition authority would picture at first.

Designing merger control

*The **second part** of this dissertation takes up where the first one left off, to the extent that it will focus on merger remedies and merger efficiency gains, but from a normative perspective. In this second part we will examine the strategic interaction between the merging firms and the competition authorities, in light of their respective individual incentives, so as to draw conclusions and recommendations for the optimal profile of the merger policy.*

Mergers involve the transfer of ownership of corporate assets. But buying and selling companies is intrinsically highly risky and uncertain business, as Seabright (2000) argues, because when one firm or corporation buys another, "it is really buying the tradeable assets in the hope that the non-tradeable ones will come too". Value creation actually comes from the non-tradeable assets (human and intangible assets), so a merger is always "a gamble on untried circumstances" (Seabright (2000)). And yet, despite this intrinsic uncertainty, mergers are to be reviewed, their market consequences assessed and eventually corrected before they even take place. In short, merger control builds on reasonable predictions more than on solid facts, and since the predictions concern not yet materialized circumstances, it is naturally subject to an important information problem.

[41] Weston (2002, p.4) claims that in response to economic, political, and technological developments, firms resort to many adjustment processes, and "it is myopic to view mergers and takeovers as the only, or main, adjustment process".

Still, it is generally agreed that merging partners have somewhat better information than the competition authorities w.r.t. the characteristics of their merger - it was early noted that "In merger review, the selective provision of information creates problems for government antitrust officials because much relevant information is held privately by merging parties" (Yao and Dahdouh (1993), p.24). *The second part of this dissertation will thus focus on some consequences of the information asymmetry between the merger partners and the antitrust authority in terms of merger control.*

This information asymmetry raises challenges both for the practice and the theory of merger control, which, together with their proposed solutions and theoretical underpinnings, will be reviewed in **Chapter 4** as an the introduction to the topic of the second part of the dissertation. This is so because basically, the information asymmetry mainly concerns one essential point in merger control, the assessment of the merger potential efficiency gains. The rationale for integrating this into the merger's competitive assessment can be traced back to Williamson (1968), who balanced the allocative inefficiency of increased market power against what the US Horizontal Merger Guidelines (as revised in 1997) call "... the primary benefit of mergers to the economy [which is] their potential to generate ...efficiencies". Efficiencies lead to cost savings and possibly to lower prices, as shown by Farrell and Shapiro (1990,a), so they implicitly determine the net market effect of the merger and thereby the possible anti-competitive character of the merger under review.

But merger control is not only about the question 'does the merger pose a threat to competition?', it is also meant to find the best way to solve this eventual threat. In terms of merger remedies, this requires that remedies as "commitments should be proportionate to the competition problem and entirely eliminate it", as the new, 2004, EC Merger Regulation clearly states (paragraph 30). On the one hand, the fact that the merger efficiency assessment is subject to the above-mentioned information asymmetry can explain the type I and II decision errors on behalf of competition authorities. On the other, given that "much of the information relating to efficiencies is uniquely in the possession of the merging firms", as the US Merger Guidelines acknowledge, these merging firms have incentives to take advantage of their private information, which further explains the difficulty for antitrust agencies to identify for instance the appropriate and proportionate

merger remedy.

All in all, it becomes apparent (Chapter 4 aims at this) that the key factors to be handled for the design of merger policy are the frequency and magnitude of decision errors and the administrative procedure costs. From this point of view, which, we might add, corresponds basically to the "error cost approach" developed in the economic analysis of law to deal with the welfare effects of legal rulemaking (see Ehrlich and Posner (1974)), the essential challenge for the theory (and practice) is how to minimize the welfare loss due to the two types of error and procedure costs. One possible answer is to optimally design the information disclosure requirements applying to the interests merging parties (see Gonzalez (2004) and Medvedev (2004,b) for theoretical propositions), which in practice has prompted the use of standards of proof and qualitative criteria for the assessment of alleged and allowable merger efficiency gains (see Röller et al. (2001) and Farrell and Shapiro (1990a, 2001)). Another possibility is to focus on the very opportunity to assess the efficiencies in terms of associate procedure costs (Lagerlöf and Heidhues (2005)), or to make a strategic choice in terms of welfare standard to be applied for this assessment (consumers' or total welfare) - see Neven and Röller (2005), Besanko and Spulber (1993) or Farrell (2003).

Chapters 5 and **6** of this dissertation advance still different ideas, such as accounting for the *ex ante* incentives provided by merger control, or designing a mechanism for the explicit extraction of the firms' private information. *In so doing, both chapters share the common background of information asymmetry between the competition agency and the merging firms, the latter's vested interest to exploit it strategically, as well as the consistent modelling of efficiencies, merger remedies and their interaction, which represents an important difference (and novelty) with respect to the vast majority of theoretical contributions on the topic.*

The view that firms should be encouraged to seek out more efficient methods of operation - including by merger - has now generally been accepted as one of the benefits of competition rather than a threat to it - this explains basically the explicit acknowledgement in merger guidelines (both US and European) of the necessity to beneficially consider efficiencies within the so-called 'efficiency defence' (which incidentally makes clear that no

'efficiency offence' is to be held against the efficiency claims). The analysis proposed in **Chapter 5** aims to signal the relevance of the method in which the 'efficiency defence' is performed, considering the impact of asymmetric information on its possible interaction with the available remedial instruments of the competition authority.

Concerning merger remedies, conventional wisdom indicates that they enlarge the set of acceptable mergers (obviously, as compared with the application of downright prohibitions). In terms of their *ex ante* incentives, Seldeslachts et al. (2006) suggest for instance that they remove the deterrence effect of the merger policy towards anti-competitive concentrations, since firms will no longer hesitate before engaging in such mergers, feeling confident that at worst, it will take a remedy to get the merger approved. However, by the same token, an overly zealous enforcement policy could lead to efficient mergers being prevented or deterred - Farrell (2003) warns that remedies as costly commitments for the merging firms "may confiscate the private rents from seeking out and pursuing efficiently-oriented mergers".

Building on this idea of *ex ante* incentives of merger control, **Chapter 5** *examines how the use of remedies impacts on the ex ante incentive effect of the efficiency defence, as well as the informational problem that the competition authority faces w.r.t. to the latter, so as to conclude on the opportunity to apply both remedies and the efficiency defence within an optimal merger control.* Thereby, we provide an answer to what should be the best merger policy, considering the relative importance of the two types of merger control errors. In short, we check for the best merger policy for maximizing expected welfare when the benefit expected from an efficient merger is high, so that it would be welfare decreasing to discourage such mergers, but also when an inefficient merger without remedies is highly harmful, so that preventing such mergers becomes very important.

The last chapter of this dissertation equally draws on the intuition of a link between the merger efficiencies and merger remedies, yet not from the viewpoint of *ex ante* incentives, but from that of the possibility to extract the merging firms' private information. By doing so, merger control can hope to optimally tailor merger remedies w.r.t. the merger's anti-competitive concern, and thereby minimize its corresponding welfare loss. **Chapter 6** thus contributes to the economic analysis of structural merger remedies by taking into

account the merger's potential efficiency gains for their design, by modelling the relation between the amount of efficiency gains that the merging partners can achieve and the amount of assets they will have to divest for the merger to be accepted.

Furthermore, *the original contribution of this chapter is to shed light on the design of optimal divestiture contracts when merging firms are better informed than the CA with respect to the merger efficiencies.* More precisely, Chapter 6 proposes a revelation mechanism based on two instruments: the amount of assets to be transferred together with their sale price. Our mechanism formalizes the possibility for divestitures, besides their corrective role, to be used for screening purposes. From this point of view, the model we propose draws on Rey's (2000) intuition that "the competition authorities could try to screen merger proposals using transfers or quasi-transfers in the form of concessions". The novelty is that not only does our mechanism aim at (and obtain) information extraction, but it also aims at explicitly accounting for the buyer's strategic incentives regarding the transferred capacity. For this purpose, we actually model the remedy enforcement within merger control as a three-party negotiation, between the competition authority, the seller and the purchaser of divested assets. Any merger remedy affects third parties by its very purpose, as it seeks to restore and maintain effective competition in the market place. This modelling choice is not only highly realistic w.r.t. the current unfolding of divestiture deals, but also takes into account the parties' respective vested interests in the merger market outcome. By so doing, the analysis in this chapter is consistent with the treatment of merger's consequences as externalities, which was, basically, the suggestion advanced by the Farrell and Shapiro (1990,a) as a seminal contribution to the analysis of horizontal mergers in oligopolistic markets.

Part I

ACCOUNTING FOR FIRMS' STRATEGIES

This first part of the dissertation proposes a spatial analysis of merger decisions and of their consequences. Chapter 1 will provide an introduction into the topic by reviewing the literature dealing with horizontal mergers in a spatial setting. Chapters 2 and 3 present in turn formal profitability analyses of spatial horizontal mergers. Chapter 2 concentrates on the impact of location choice for the profitability and rationale of Cournot horizontal mergers. Chapter 3 extends the spatial profitability analysis by considering a wider corporate strategy, allowing for both merger and de-acquisition.

Chapter 1

Horizontal market concentration: Insights from the spatial models

"What does it mean to refer to the 'market' when the geographic extent of the market is a single point and all firms in the market produce a homogenous good?"

(McAfee et al. (1992) - p.350)

1.1 Introduction

Quoting the Allianz AG investor relations news[1] dated September 11, 2005, "...the full acquisition of RAS (Riunione Adriatica di Sicurtà (RAS) S.p.A) will enable Allianz in the future to reorganize its Italian activities and to directly reallocate the holdings of operations to Allianz Holding in key European markets[...] Furthermore, the management board of Allianz AG decided to consolidate the insurance activities of the Allianz Group in Germany under one German holding company to be newly created."

This merger arguably opened opportunities to reduce the complexity of the entire Group, as became clear earlier this year. According to the investor relations news from June 22, 2006, "Allianz plans to introduce a new operating model and merge locations within Germany[...] to make its insurance business even more client-focused, to operate more efficiently and achieve growth. By 2008 the group intends to have introduced a new business model which will include an updated concept for geographical locations[...] there will be cost savings of between 500 to 600 million euros from which both clients and shareholders will profit[...]Allianz is planning to cut back the number of administrative locations in Germany from the current twenty one to ten."

Post-merger spatial repositioning is only one of the topics concerning horizontal market concentration looked at in this introductory chapter. It is a most common business strategy, although not necessarily in its geographical sense. Berry and Waldfogel (2001) study the consequences of a major radio station consolidation wave in the US prompted by the natural experiment of the 1996 Telecommunications Act, which substantially relaxed previous ownership restrictions in the industry. Using a panel data set on 243 US radio broadcast markets before and after the Act (in 1993 and 1997), they find that concentration reduces station entry, but, holding the number of stations constant, increases product variety. In addition, their regressions show that jointly owned stations are more likely to broadcast in similar formats than independent unrelated ones. In other words, mergers trigger product specification changes, and the study recommends that "antitrust authorities considering radio mergers might want to take such effects into account when

[1] For details see the Allianz AG website: www...

they try to anticipate the effect of mergers on overall welfare".

A spatial analysis of mergers brings further insight into the merger consequences, and for the possible reply of competition authorities in terms of merger control. This chapter attempts to argue these statements. While doing so, it frames the original theoretical contributions of chapters 2 and 3.

1.1.1 Relevance and purpose

Distance, either in its geographic or product specification meaning, gives rise to differentiation. Branded consumer products, where each brand of pens, or bread, or computer software, or cereal, is distinct, are easy examples of differentiation within the product range. Physical facilities that distribute or deliver goods or services, such as supermarkets, department stores, branch banks, or hospitals, give rise to differentiation based on location. Even in a classic homogeneous-goods market (such as the market for an agricultural commodity or for a specific chemical compound) producers do differentiate themselves spatially. To a greater or lesser degree, virtually all markets involve some element of product differentiation.

From a positive standpoint therefore, the economic analysis of mergers in oligopolistic markets needs to take into account such product repositioning or geographical (re)shaping of a distribution network following horizontal market concentration, as mentioned in the above examples and made relevant by the differentiation (spatial or product range). To address such consequences of mergers, a spatial framework is thus necessary. But the spatial setting can equally provide a consistent framework to examine firm behaviour induced by a given spatial setting. More precisely, particular location patterns for production or distribution outlets of merger partners, or various degrees of product differentiation within their product range, provide different incentives to merge, to monopolize the market, to free-ride on a merger between rivals, or to prevent the market entry of rivals after merger. And since mergers do trigger location choices, as the above examples remind, spatial models are helpful in predicting whether more or less geographical agglomeration (or if more or less diversity) is (are) to be expected. Furthermore, a spatial analysis can assess the spatial repositioning/product design choices made by firm in anticipation of mergers, and

as such may contribute to the antitrust market surveillance.

From a normative point of view, the insight provided by a spatial merger analysis can only improve the outcome of merger control. To put it short, mergers lead to structural changes in a market, and the equilibrium which emerges following a merger is likely to be different from that which prevailed before. The purpose of merger control is to assess the nature of the likely post-merger equilibrium and to make a welfare comparison between this expected outcome and the pre-merger situation. In making such a comparison, the main variable of interest is likely to be the level of post-merger price(s) compared to pre-merger one(s), given the current focus of merger control on consumer welfare. This typically involves answering three questions. Would prices be expected to rise significantly if there were no cost savings from the merger and there were to be no new entry or product repositioning by rivals? Will entry or product repositioning thwart any attempt to raise prices? What is the likely impact of the merger on costs? Spatial models can arguably provide answers to all these questions, and not only. Even before weighing the possible cost savings and other consequences from relocation/repositioning, the very antitrust assessment of the merger's effects actually begins by defining the relevant geographic and/or product market.

In all cases, firm behaviour and "location" appear to be related and important for the economic analysis of horizontal mergers, both from a positive and a normative point of view. *This chapter will review the theoretical literature dealing with horizontal mergers in a spatial setting by focusing on the two-way relationship between firms' locations and their behaviour.* We shall first explore the incentives conveyed by locations for firms' merger and merger-related strategies, then go on to address the impact of merger on location choices.

However, before doing so, the underlying formal background will be discussed in the following subsection. The various modelling assumptions having different implications for the ultimate outcome of the spatial analysis, presenting them first is useful for pinning down later on the origin of the location and/or behaviour effects that are dealt with in the merger literature.

1.1.2 Modeling framework for horizontal mergers in a spatial setting

The literature on horizontal mergers in a spatial setting relies on oligopoly as well as location theory models, both whose predictions are highly sensitive to the assumptions underlying them. It would be inappropriate to take a single model of oligopoly behaviour in a given spatial paradigm and attempt to interpret market behaviour or draw generalized policy conclusions from it. To better grasp the various characteristics of the different analytical models used to perform a spatial analysis of horizontal mergers, the following paragraphs briefly list their main ingredients.

Spatial representation of the market

Any spatial model of mergers necessarily builds on a given pre-merger location equilibrium, which most often than not is examined either on a linear or a circular market. These geometric analogies are the most frequent and tractable ways to model spatial differentiation, be it geographical or within a product range. Hotelling's (1929) ice-cream sellers moving along a linear beach recall that a spatial representation such as the segment allows for differentiation through location. A set of consumers with preferences defined over a set of goods can also be formalized by such a location model, as long as it is possible to order the different brands (from left to right, for instance , much as beer varieties naturally range from dark to light in a linear manner). In such a case, consumers' disutility in putting up with less than their ideal variety will be basically modeled as a transport or tariff cost.

Interestingly enough, the linear market assumption turns up more frequently because locations are *a priori* heterogenous on the segment, which makes it interesting to determine location patterns arising from various market characteristics. It is recognized however, that the circular framework is more appropriate for certain real-life situations. Typical examples are circular towns spreading around lakes, for which consumers cannot generally afford to cross the lake when going shopping, and therefore department stores take up their locations around the lake. More generally speaking, this basically occurs for every traffic-jammed city - large shopping malls are located on the outskirts, on the circular belt-way, so as to avoid consumers the downtown traffic. Furthermore, the dial of a clock is basically a circle, so the circular market can be used for competing television networks choosing

time slots for their shows, or airlines choosing arrival and departure times for their flights. Still, in terms of product specification, the linear representation is often preferred because it applies to single-peaked consumer's preferences, whereas no such analogy is available for the circular model. In all cases, choosing one spatial representation over the other is justified by the particulars of the situation at hand.

Market interaction

Such a conclusion equally holds when deciding to model price rather than quantity competition. The choice is important for the merger analysis, and we shall dwell on its importance later on, but basically it depends on the nature of the product considered. From a theoretical point of view, as indicated by Kreps and Scheinkman (1983) in a non-spatial framework, the Cournot equilibrium obtains is equivalent to the outcome of a two-stage game where firms set quantities first and then compete in prices. Conseqeuntly, Cournot competition is relevant when the quantity (or capacity) decision of the first stage is inflexible, meaning basically when fixing prices is easier than modifying capacities or adjusting quantities[2].

In a spatial context, firms often decide on their aggregate output but also on the quantity to allocate to different submarkets. Following the above reasoning, the Cournot assumption appears reasonable when both total capacity and the spatial allocation of output are relatively inflexible. Typically, such a rigid spatial distribution of the firm's sales is consistent with the setting where firms ship/deliver output from a production plant to various outlets/consumer locations. In turn, if a product's price is heavily advertised (like catalog stores), changing the price involves a substantial cost for the firms. Prices are the relevant choice variable in this case, so Bertrand competition is more realistic. This makes price competition quite popular with consumption goods and the related shopping behaviour on behalf of consumers. Still, the Cournot assumption is relevant on a larger scale than the above examples imply. From a theoretical point of view, Cournot spatial models have attractive features in their predictions: whereas Bertrand competition yields

[2] This makes it particularly appropriate for modelling heavy industry - typical examples are the markets for oil, natural gas, cement and ready-mixed concrete - see Salant (1982) for a study of the world electricity market and McBride (1983) for the American cement market.

exclusive sales territories for firms[3] (consumers at each location being served only by the most cost-efficient firm there), Cournot competition exhibits market overlapping with intra-industry trade, which often does fit reality better - see Phlips (1983) and McBride (1983). In any case, the intensity of the oligopolistic rivalry, Bertrand and Cournot, will prove essential for the ultimate spatial pattern characterizing the merger equilibrium.

The spatial pattern generally depends also on the spatial pricing policy. A major contribution of the literature on strategic location in oligopoly was precisely to show that a connection necessarily exists between the location market equilibrium and firms' pricing policies. Two alternatives are basically possible, either spatial price discrimination[4] or nondiscriminatory pricing. The latter occurs whenever two varieties of a product are sold by the seller to different buyers at the same net price, which is the price paid by a buyer corrected for the product differentiating cost (Phlips (1983), p.6)). Consequently, the only nondiscriminatory spatial pricing is the mill f.o.b. (free-on-board) pricing, which has all consumers pay the same mill price and then pay the full transport cost to their own consuming locations. In turn, spatial price discrimination can occur under two equivalent forms: either through the charging of different mill prices to buyers at different locations, or through delivered prices at which the product will be supplied at the various local markets.

The spatial literature combines these assumptions on intensity of competition and spatial pricing policies in two principal alternative paradigms, the so-called shopping and

[3] Price competition with homogenous product in spatial markets always implies non-overlapping market areas for competitors, and this is true for both mill and spatial discriminatory pricing, as shown by d'Aspremont et al. (1979) and Lederer and Hurter (1986).

[4] Price discrimination occurs when the price differences do not result from generalized (i.e. accounting for transport) production cost differentials. According to the standard microeconomic theory, a firm may discriminate in price if it can separate its overall market into several distinct submarkets between which demand elasticity varies. 'Space' is the most natural criterion to separate consumer markets, with 'distance' standing for tariff costs, or waiting time, or storage costs, or product differentiation. In addition, distance costs generate varying demand elasticities between spatially separated markets, even if demands are identical everywhere. As a result, as long as firms control the means of market separation, in absence of institutional or legislative constraints, spatial price discrimination may naturally arise instead of nondiscriminatory pricing.

shipping models. Assuming mill pricing and letting consumers in charge of the transport cost represent the basic assumptions of the former, more often than not associated with Bertrand competition. In turn, modelling firms that transport goods to observable consumer locations and thereby spatially discriminating customers corresponds to the shipping model, which is usually combined with Cournot competition. The choice of one framework over the other depends on whichever fits better the situation examined.

For instance, market segmentation as resulting from discriminatory delivered pricing in the shipping framework enables profit maximization behaviour to be considered separately for each local market, which is particularly relevant for the international location case, where arbitrage costs between locations are likely to be high. This framework was extensively used in international trade theory, see for instance Brander and Krugman (1983). Fujita and Thisse (1997) explicitly draw attention to the fact that the distinction between the shopping and shipping frameworks in location models corresponds to that between integrated and segmented markets in international trade models. In turn, the shopping mill pricing model is realistic when consumer's location/most preferred variety not easily identifiable. A shipping model can furthermore approximate the mechanism of flexible manufacturing described by Eaton and Schmitt (1994), where the basic product (standing for the location of the firm) is customized at a certain cost (here, the shipping cost) to make it available to consumers.

In other words, both frameworks are practically relevant, and correspond to particular interpretations of the spatial setting. However, *our survey of the theoretical literature dealing with horizontal mergers in a spatial setting will purposely dwell more upon the implications of the Cournot shipping framework, so as to better introduce the original contributions of chapters 2 and 3, building precisely on this setting.*

1.2 Impact of location on behaviour

1.2.1 Basic insights from strategic location theory

A major contribution of the strategic location theory was to establish that a firm's optimal location is generally determined by its pricing strategy, the shape of the indi-

vidual demand, the form of the delivery cost functions, the conjectural variations of the competitors, the particular distribution of consumers, and the degree of competition in the industry. The abundant literature on strategic location gradually studied the impact of all these factors on the ultimate spatial equilibrium, with one conclusion being soon obvious, namely that results are quite sensitive to assumptions. Still, a firm's location decision always results from the same general trade-off, between agglomeration and dispersion forces. Intense competition typically generates dispersion, but 'be where demand is' gives common incentives to cluster, just like possible positive strategic interactions (such as positive externalities among firms, or the existence of a market center). At any rate, strategic location models are always concerned with minimizing overall transport costs, and the trade-off between agglomeration and dispersion is settled by firms choosing their distance to each consumer's location so as to maximize profits.

A pioneering contribution to the location theory was made by Hotelling (1929) w.r.t. the Bertrand mill pricing shopping model on the linear city. With linear transport cost and uniform consumer distribution on the unit line, he obtained for the duopoly sequential location-price game the principle of minimum differentiation or, equivalently, central agglomeration, with firms locating back to back at the market center. Yet, a closer look at the demand and profit functions reveals they are both discontinuous for close enough locations, and profits are not quasi-concave due to the possibility of price undercutting. The price competition stage is actually not well behaved, and eventually d'Aspremont et al. (1979) show that if firms are located near the segment mid-point, a pure-strategy price equilibrium fails to exist[5].

However, with quadratic transport cost the location-price problem becomes tractable again, and maximum differentiation obtains instead, with firms locating at the market endpoints (see d'Aspremont et al. (1979)). Basically, this result stems from the need for firms to locate as far as possible from each other so as to avoid triggering a price undercut from the rival and thus soften the intense price competition. Still, the product homogeneity can be questioned, and a supplementary product differentiation dimension

[5] Hotelling's central clustering result remains valid as long as prices are fixed and identical for both firms, because the incentive to differentiate products decreases when firms do not actually compete in prices.

is enough to mitigate the extreme dispersion outcome[6]. Shopping models with Bertand competition on the linear market restore the minimum differentiation result, provided transport costs are not too high and products sufficiently differentiated along some other dimension[7]. By the same token, the pricing policy assumption[8] was questioned, as well as the possibility of rational undercutting without fear of retaliation[9]. Moreover, the existence of endpoints on the bounded linear market gives rise to some difficulties concerning the existence of pure-strategy equilibrium, especially when more than two firms compete in the market[10]. This prompted the use of the alternative circular space assumption. The circular city was pioneered by Vickrey (1964) in its modern version[11], yet made popular by Salop (1979) through his analysis of free market entry equilibrium and socially optimal degree of differentiation. His model postulated the symmetric equidistant location by oligopolists on the circular market, which, although highly intuitive, was only shown to be an equilibrium later. Economides (1989) provides existence and uniqueness results in the circular location-then-price model with quadratic transportation costs, while Kats (1995) obtains the equidistant location pattern as a location-price equilibrium for a duopoly with linear transport cost, and finally De Frutos et al. (1999) establishes the equidistant pattern as an equilibrium for a larger class of transport cost functions.

Although price competition occurs on a large scale, the alternative quantity competition assumption is equally realistic. Given the empirically confirmed relevance of the

[6] The nonspatial price competition model allows nonzero equilibrium profits if products are differentiated. The resulting lower intensity of competition gives more weight in a spatial setting to transport cost minimization, and firms can agglomerate to better serve demand.

[7] See Irmen and Thisse (1998), de Palma et al.(1985), Anderson and de Palma (1988) and Ben-Akiva et al. (1989) for models with a supplementary product differentiation dimension.

[8] By considering spatial discriminatory pricing and reverting to linear transport costs, Lederer and Hurter (1986) show that duopolists locate at the market quartiles

[9] Novshek (1980) suggested to look for equilibrium in the simultaneous location-price game under the assumption of no-mill-price-undcercutting whenever linear transport cost are used. The problem raised by these is that consumers care as much for the price they have to pay as for the distance they have to travel, so firms basically perceive price and location as strategic substitutes, hence the opportunity of undercutting for too close locations.

[10] See for instance Economides (1993) for a nonexistence result for more than three firms in the sequential location-price model on Hotelling's line.

[11] An earlier version is due to Lerner and Singer (1937).

Cournot assumption[12], an increasing bulk of the location theory literature has built on it. Salant (1986) examined perfect equilibrium existence in a shopping model on the segment market by allowing firms to enter and choose locations one at a time, before competing in quantities[13]. The spatial pattern thus obtained does not have firms equally spaced, nor making equal profits, although symmetry w.r.t. the mid-point may apply. More importantly, Salant (1986) equally shows that the equilibrium may fail to exist when simultaneous location-quantity choices[14] are considered instead, much as in the price model, due to the profit function discontinuity. As a result, the location pattern for spatial Cournot competition has typically been studied in the sequential location-then-quantity competition framework[15].

Assuming linear transport costs and identical linear inverse demands for consumers uniformly distributed on the unit segment, Hamilton et al. (1989) obtain the existence of a unique equilibrium pattern of central agglomeration for a two stage location-quantity duopoly game. The result is extended to convex transport costs and moreover, generalized to n firms in the case of linear transport costs by Anderson and Neven (1991), which has virtually become since the building framework[16] of the mainstream spatial Cournot analysis. It should be noted that besides providing theoretical foundation for the common observation that firms selling similar products frequently agglomerate in space, Hamilton

[12] See Salant (1982) for the world electricity market and McBride (1983) for the American cement market.

[13] The sequence of moves and the Cournot assumption guarantee the continuity and (quasi)concavity of profits, and thereby equilibrium existence.

[14] There are cases where changing the firm's position in the product range (typically, the colour, or Hotelling's example of cider sweatness) is virtually costless, so location and output choices are basically simultaneous.

[15] In spatial models, when dealing with the choice of physical locations, it is not out of place to suppose that that a firm must settle on a location before deciding on the level of output. Similarly, when a firm's location decision represents the choice of a position in a product space, it is frequent that location (i.e. product design) must be chosen before prices and/or output levels be selected. For many differentiated product oligopolistic industries where durable and product specific inputs must be acquired prior to production, location decisions naturally precede quantity choices.

[16] Their paper draws attention to the relevance of (inverse) demand assumptions leading to this outcome: the linearity and a sufficiently high reservation price. The former ensures profit quasiconcavity, and hence equilibrium existence, while the latter rules out local monopolies.

et al. (1989) and Anderson and Neven (1991) incidentally claim that an alternative way of modelling inter-firm rivalry than price competition can *per se* provide a reason for agglomeration.

Much of the subsequent literature on spatial Cournot competition tested the robustness of this result. Hamilton et al. (1994) study the same duopoly location-Cournot game on the segment, but with mill f.o.b. pricing and shopping behaviour instead of spatial price discrimination, only to revive a well-known equilibrium existence problem (as a result, the perfect equilibrium of the two-stage game yields almost (but not exactly) central agglomeration). Besides the pricing policy, demand and cost factors equally challenge the central clustering result. Gupta et al. (1997) consider different types of demand distribution and prove that a necessary condition for agglomeration to occur at a given point in space is that the density of demand be sufficiently high at that location[17]. Mayer (2000) reminds that strategic location requires minimizing total delivered costs to consumer locations, and that production costs are part of that total delivered cost. Instead of normalizing the constant marginal production cost to zero as it has always been done before, he reintroduces it into the duopoly game, to show that transport and production costs do not weigh equally within the location choice decision. Mayer (2000) gives the two alternative necessary conditions that enable central agglomeration: either the production cost distribution be uniform, or such that production cost be minimized at the middle of the segment. As a result, Anderson and Neven's (1991) result is also explained by the fact that production costs are identical at all locations. Finally, Anderson and Neven's (1991) uniqueness result is to be put down to the particular assumption concerning the shape of the spatial market. With constant marginal delivery cost, a necessary condition for a given location to be optimal is to satisfy the quantity-median property, meaning that for that location, total quantity supplied to the left must equal that supplied to the right[18]. Clearly, for a location equilibrium pattern, all firms must be located at their quantity-median point, and since the segment market is exogenously bounded, the quantity-median location is

[17] Hence, the central agglomeration outcome is explained by the symmetry of the uniform distribution initially assumed, whereas a multi-modal distribution could sustain several distinct clusters on the segment.

[18] A firm's profit is proportional to the square of the quantity supplied on the market, so this is merely a translation of a firm's First Order Condition on its total profit over the set of spatially segmented markets.

identical and unique for all firms.

A growing body of articles choose instead to model the circular city, with two main findings: multiple equilibria obtain generally, none involving complete agglomeration. Pal (1998) was the first to point out the latter for the symmetric duopoly on the circular city. He finds that firms disperse at the opposite ends of a diameter, and therefore that the shipping Cournot model can be consistent with the maximum differentiation principle. Matsushima (2001,a) increased the number of firms on the market to obtain instead partial agglomeration-dispersion, with firms dividing into two equidistant clusters located at the opposite ends of a diameter. Shimizu and Matsumura (2002) completely generalize the framework, to show that complete agglomeration cannot possibly be sustained in equilibrium on the circle, and identify other equilibrium location patterns[19].

The circular model is thus consistent with an appealing partial clustering result, given the common observation of firms agglomerating in several major business areas, each involving a different number of competitors. However, the multiple equilibria property raises questions as to the model's predictive powers, all the more so that not all equilibria have yet been characterized. Still, the circular model unravels one further important insight into the origin of the initial agglomeration result obtained by Anderson and Neven (1991). Complete agglomeration cannot be obtained on the circle due to the product homogeneity assumption, which implies strategic substitutability for quantity competition, and makes agglomeration reduce output for every firm in the cluster. Spatial Cournot competitors would naturally disperse to maximize profits, but this is not possible on the segment, where the exogenous borders impose the same most-preferred transport cost minimizing location to all competitors. Without this dominant intrinsic agglomeration force, Cournot firms selling a homogenous product can and do disperse on the circle[20].

[19] Gupta et al. (2004) further confirm and extend the multiple equilibria property, by showing that firms tend to locate pair-wise on the circle in various spatial patterns, partially agglomerating at distinct locations, often in a non-equidistant equilibrium, and possibly in a continuum of location equilibria.

[20] The point was definitely settled by Shimizu (2002) and Yu and Lai (2003), who allow for product differentiation (each firm shipping one variety) within the original Cournot duopoly on the circular market. With perfect substitutes, Pal's (1998) equidistant result is confirmed, but in the case of complements, which imply that a firm sells more at the rival's location, firms necessarily cluster.

To sum up the theoretical results reviewed so far, the spatial equilibrium necessarily consists of dispersion if firms compete in prices, and may involve complete agglomeration, partial clustering or even complete dispersion if instead firms compete in quantities, depending on the market's characteristics.

1.2.2 Merger analysis and some antitrust insights

The main findings from location theory reviewed in the previous paragraphs are relevant for a spatial merger analysis to the extent that they can be used to characterize the initial pre-merger spatial market equilibrium, and this would be the first step of an explicit merger assessment. We turn now to the literature focusing on mergers in a spatial setting, and examine the behaviour incentives induced by a given spatial pattern.

When studying the incentives for (and, equally, the consequences of) market power increases in a spatial setting, considering fixed locations provides basic insight, besides being the simplest modeling framework available. In a sense, the fixed-location merger models were the initial extension of the nonspatial analyses, and the earliest spatial contributions to the horizontal merger literature basically checked for and extended results obtained in nonspatial models.

One of the main findings of the latter, and possibly the most quoted, is the so-called merger profitability paradox. Despite the recurrent merger waves, both theoretical and empirical studies indicate that often merging partners incur a profitability loss, whereas outsider firms experience a profitability raise following the merger. This is disturbing, all the more so that for insiders the profitability loss can be so high as to question the very incentive to merge in the first place. The theoretical literature pointed out that the intensity of the paradox actually depends on the underlying assumption on market competition, to the extent that in nonspatial models, Salant et al. (1983) concluded on the lack of private incentives to merge for identical Cournot firms producing a homogenous good with constant unit production cost[21], unless their market shares amount to at least 80%, whereas Deneckere and Davidson (1985) revealed that a merger is always internally

[21] Also, absent market entry and without cost savings - for a more general Cournot model see Szidarovsky and Yakovitz (1982).

profitable for Bertrand producers of differentiated goods, at least if entry is not an issue. In the first model, since quantities are strategic substitutes, an output contraction by insiders triggers an output expansion by rivals, while in the latter case, prices being strategic complements, the insiders' price raise is matched by a similar price increase on behalf of the outsiders[22]. In both cases, as signalled by Stigler (1950), outsiders benefit more than the insiders from the merger, and this free-riding effect may eventually prevent the merger if the decision to merge is endogenized.

As already mentioned, spatial differentiation is substitutable to product differentiation, so it should not come as a surprise that horizontal Bertrand mergers in spatial models basically yield the same results. Levy and Reitzes (1992) consider bilateral (profitable, of course) horizontal mergers between neighbouring Bertrand competitors in Salop's (1979) model and check that outsiders make lower profits than insiders, except for the two adjacent firms, whose profits increase. This is due to the assumptions of shopping behaviour and nondiscriminatory mill pricing, which imply together that competition is asymmetric and strongly localized. In this model, a firm only competes directly with its two neighbours[23], so it gives up merging only if it anticipates that any of its neighbours will merge, because the free-riding effect is restricted to the two closest neighbouring firms. Reitzes and Levy (1995) show instead that if firms can spatially price discriminate, this free-rider problem vanishes. Within a shipping model with symmetric Bertrand competitors that spatially price discriminate, they find that the equilibrium prices of outsiders are not affected by a merger (of course, profitable) between neighbouring firms, but they increase for consumers located between the insiders. This is due to the fact that in markets with spatial discrimination, a firm's price is dictated by the delivered cost of its adjacent rivals, so only mergers between neighbouring firms influence price[24].

This idea that the pricing strategy of a product line over a geographic area largely

[22] The importance of the strategic complementarity for the existence of the paradox was equally signalled by Gaudet and Salant (1992).

[23] In contrast, Deneckere and Davidson (1985) assume that varieties are imperfect substitutes and each firm competes symmetrically with all rivals.

[24] The ability to discriminate is compatible with the localized asymmetric competition, inasmuch as insiders choose delivered prices so as to prevent any free-riding from their neighbours.

depends on the intensity of local competition that each individual firm, store or brand faces, basically suggests that it can be strategically advantageous for a multiproduct firm (resulting from a horizontal merger typically) to base its pricing policy on the degree of substitutability between own brands and those offered by rivals. Using the standard (i.e. shopping behaviour with quadratic transport cost) circular model of product differentiation with Bertrand competition, Giraud-Héraud et al. (2002) consider mergers between a multiproduct firm selling a group of connected brands and one single-store/product competitor. Assuming fixed symmetric equidistant locations for all brands around the circle, they find that the merger with an adjacent competitor is increasingly profitable as the number of brands controlled by the group grows larger and larger. Moreover, due to the asymmetric pricing policy devised by the group, closely-substitutable target brands experience a profit increase, so the free-riding problem is absent for the group's closest neighbours. Giraud-Héraud et al. (2002) stress that profits vary among the group's brands, depending on the exposure to competition from fringe competitors, and equally suggest that the latter may more or less benefit from the free-riding effect in case of merger. This suggestion is exploited by Brito (2003), who reminds that often outsiders abandon the passive free-rider behaviour to try to prevent the merger. This might appear puzzling, but it is explained by the fact that firms may engage in preemptive mergers to avoid becoming profit-loosing outsiders of alternative mergers. Brito (2003) obtains this result by endogenizing the decision to merge in Levy and Reitzes's (1992) model, and thereby actually unveils a possible rationale for unprofitable mergers to occur.

Matsushima (2001,b) equally investigates endogenous sequential mergers, but between four identical firms in the circular-city shipping Cournot model. Although the main motivation of the paper is to study merger waves, it also obtains that a merger between neighbouring Cournot competitors is unprofitable. This amounts to extending the merger paradox in spatial Cournot models, despite the added feature of spatial product differentiation. Indeed, with Cournot competition and spatial discrimination, each point in space is an independent local market supplied by all firms, proportionally to the distance from their own locations. To get rid of overlapping market areas, and to minimize transport costs, one of the insiders stops supplying at those locations where it does not have the

lowest marginal delivered cost, hence an output contraction for the merged entity. Thus the nonspatial model basically obtains at each local market, as first pointed out by Norman and Pepall (1998). Their paper is a reply to McAfee et al. (1992), who alleged that Cournot horizontal concentration would prove profitable in the spatial setting simply because the merged entity is 'larger' than the outsiders: indeed, it continues to operate two distinct outlets, contrary to the Salant et al. (1983) symmetric nonspatial model, where it is shrinks to the size of an outsider. Norman and Pepall (1998) provide actually a necessary condition for a horizontal merger to be internally profitable, namely sufficient marginal delivery cost heterogeneity between insiders[25].

Matsushima's (2001,b) primary purpose was to study merger waves, and from this point of view, the paper finds that if the transportation cost per length is sufficiently large to market size, then a wave of profitable mergers occurs, leading to the market being eventually monopolized. Giraud-Héraud et al (2002) also hint at this, since for the group of brands, acquiring an adjacent single-product firm is all the more profitable that its number of brands is large. This reminds that it takes a strong free-riding effect on behalf of the outsiders to contain the monopolization incentive.

Hold-up of procompetitive and welfare enhancing mergers is of course not desirable. However, as many mergers are on the contrary anticompetitive, the free-riding can actually save time and money for competition authorities. Thus, in the model considered by Levy and Reitzes (1992), the outsiders' free-riding can discourage price-increasing mergers due to the localized nature of competition. The latter explains the anticompetitive effect of the merger, and underlines the importance from a competition policy point of view of the definition of the relevant market for merger analysis. Indeed, with localized competition, the ability to exercise market power is concentrated among nearby firms (the

[25] Note that this is the 'spatial' translation of the merger paradox solution suggested by Perry and Porter (1985) in the nonspatual framework, i.e. a cost asymmetry between merger partners.

Matsushima (2001) basically confirms this idea, to the extent that for very high transport cost per distance, and given the equidistant locations fixed in the beginning of the game, a merger of opposite competitors can be profitable, provided though a subsequent merger is anticipated. For a merger between diamterically located firs, the cost asymmetry is highest, so the ensuing cost savings in terms of transport cost minimization and output reallocation between affiliates are largest.

post-merger price increases after a merger between close substitutes). In this case, the antitrust market is necessarily highly concentrated, so focusing on market concentration may be irrelevant in markets with localized competition - instead, the 'closeness' of competition and 'submarkets' can prove more appropriate for the antitrust analysis.

This represented one of the important revision points of the US Merger Guidelines in 1984, in acknowledgement of the fact that: "When products in a relevant market are differentiated or sellers are spatially dispersed, individual sellers usually compete more directly with some rivals than with others" (Revised Merger Guidelines §49, 1984, US Department of Justice). More precisely, depending on the current focus of the merger assessment, i.e. either unilateral or co-ordinated effects, either a localized competition criterion or a market shares measure appears more reliable[26].

The idea that with spatial settings a particular market definition might be more appropriate is really more general than the Levy and Reitzes (1992) localized competition model implied. McAfee et al. (1992) suggested the same, but in a Cournot shipping model where firms price discriminate. In such a model[27], at every local market a firm competes against all others, so the intensity of rivalry is symmetric and not localized. Instead of the two-step market assessment procedure of the US Merger Guidelines[28], McAfee et al.

[26] According to the "Merger appraisal in oligopolistic markets" report prepared in November 1999 for the UK Office of Fair Trading, in markets in which products are differentiated, market shares can provide an unreliable guide to the possible extent of any unilateral effects. (Unilateral effects arise when two closely competing products are brought under common ownership. The term unilateral effect refers to the fact that the post-merger firm has an incentive to raise price even if the merger has no effect on the behaviour of competing firms.) In cases such as this, it is often more informative to directly assess the proportion of each of the merging firms' customers who would have switched to the other merging firm's products following a price rise.

In markets in which products are undifferentiated, market shares are much more likely to give a reasonable indication of the possible extent of post-merger price increases. In homogeneous product markets, the most important concern may not be that the merged firm will engage in unilateral price rises, but that the entire market will become tacitly or explicitly collusive after the merger. Post-merger effects that rely on the behaviour of the merged firm's rivals are termed co-ordinated effects.

[27] Incidentally, attention is drawn to the fact that applying the Hirschman-Herfindahl Index to assess market concentration is not an equilibrium criterion, because insiders reallocate output between them after merger so as to minimize total delivery cost and eliminate overlapping sales territories.

[28] The relevant market is first defined by means of the 'hypothetical monopolist' paradigm, then market

(1992) proposes a one-step evaluation based on the estimate of increase in the equilibrium post-merger delivered prices. This suggests a different notion for the relevant antitrust geographic market: unlike that provided by the Merger Guidelines, a larger area with this definition causes higher concern, since it indicates that a larger number of consumers will be adversely affected by the merger.

Besides an appropriate market definition, the competition authority could (and should?) consider also alternative mergers in order to achieve a proper evaluation of the merger's negative effect. In the circular model of Levy and Reitzes (1992), modified to allow for production cost reductions through asset ownership *à la* Perry and Porter (1985), Brito (2005) shows by means of a revealed preference argument that the comparison, in terms of prices, between a profitable merger between neighbouring firms and the most profitable alternative merger between nonneighbouring firms, establishes an upper bound on the amount of cost savings that can be obtained through the concentration. Checking this threshold against the minimum efficiency gains necessary for a merger to avoid a price increase allows a better assessment of the merger's likely (anti)competitive effect.

The expected competitive change following the merger is equally related to the possibility of product/store relocation and/or market entry. Fixed-location spatial models are of course somewhat restrictive in this respect, yet they do provide some basic intuitions. In their Bertrand competition framework, Reitzes and Levy (1995) point out that the lack of free-rider benefits from merger removes for outsiders the post-merger incentives to relocate or for potential entrants to enter the market, and since it is the spatial price discrimination that restrains free-riding in their model, it follows that price discrimination can facilitate entry deterrence in spatial markets. The issue of entry is also examined by Deck (2001), in a Hotelling-type mill pricing shopping model with fixed costs allowing for both firm and outlet operation choice. The main purpose of the paper is to stress that a spatial framework may better seize the consumer adverse effects of a merger. Following a bilateral merger within a triopoly, firms decide to operate or not all outlets before

concentration is assessed by the Herfindahl-Hirschman Index. If firms can price discriminate, the 1992 US Merger Guidelines state that "...the Agency will consider additional geographic markets consisting of particular locations of buyers in which a hypothetical monopolist could profitably and separately impose at least a 'small but significant and nontransitory' increase in price."

competing in prices. Any mergers is profitable, thanks to fixed cost reductions, but for a non-contiguous merger between distant firms, it is even more profitable to shutter one of the outlets. This actually hurts consumers in two ways: higher prices and increased travel cost. Indeed, in a spatial framework, where outlet location stands for product brand, a merger equally modifies welfare through the number of outlets operating afterwards, because this determines the total transport cost/disutility incurred by consumers. A possible antitrust response to such an anticompetitive merger is to require that both affiliates be kept open after the merger. The same result in terms of outlet-operating strategy obtains for a merger between neighbours, yet the above antitrust remedy is ineffective in this case, since prices will still be higher than before merger. Deck (2001) also checks that the threat of entry gives the same incentives as the antitrust remedy in the case of a non-contiguous merger, which basically conforms with the (nonspatial) idea that entry and merger remedy are substitutable[29].

The same is claimed by Cabral (2003), but with a different antitrust moral, in a Salop-type standard shopping model where the possibility of entry is considered both before and after a merger to monopoly. Depending on the comparison between the reservation price and the sunk fixed cost per location, the market is deemed either small or large. In the former case, entry is unprofitable both before and after merger, so consumers only buy from two diametrically-opposite stores, and the price goes up following the concentration. In larger markets, however, the merger can trigger entry by a third firm, which locates its store half-way between the insiders, and thus makes both prices and consumer transport costs fall. The paper argues that in this case insiders may anticipate post-merger entry and strategically react by proposing to divest one outlet in order to have their merger more easily accepted. By doing so, they succeed in 'buying off' the third firm, which would not open another store besides the one already acquired as a means for entering the market. This ultimately restores the symmetric one-store duopoly, which from the consumers' point of view is worse than an asymmetric three-store duopoly that might have obtained otherwise. The main point is that voluntary asset sale chosen and designed

[29] The 1992 US Merger Guidelines §3 state that "in markets where entry is ...easy,...the merger raises no antitrust concern and ordinarily requires no further analysis".

by insiders can actually block entry, as compared with a divestiture injunction optimally designed by the competition authority, on account of the insiders' incentive to strategically anticipate both rivals' action and merger control procedures.

This conclusion can only strengthen our point developed in the next section, dealing with the location incentives conveyed by mergers. After all, it is increasingly acknowledged that the merger antitrust assessment ought to deal with the expected post-merger situation by taking into account store/firm relocation and/or brand repositioning for the assessment of merger effects on industry performance and consumers' welfare.

1.3 Impact of behaviour on location

If merger analysis with fixed locations yielded conclusions on the effect of locations for merger incentives and merger-related strategies (such as outsider free-riding or entry pre-emption), the converse can be studied in terms of the impact of exogenous mergers on endogenous locations. Allowing for location choice when dealing with mergers in spatial settings represents an equilibrium approach, to the extent that it allows the assessment of strategies such as post-merger relocation or pre-merger location choice with foresight of merger. Both are empirically relevant, the former in the sense of product range repositioning or geographical reshaping of a distribution network for instance, the latter whenever location represents an investment decision, because this is often made before engaging in take-overs[30]. Furthermore, from a spatial point of view, endogenizing location choice provides insight for the relation between market concentration and spatial agglomeration or dispersion on the one hand, or product diversity on the other.

The literature on this topic is not vast, and most of it falls into two analytical frameworks. Most often than not, spatial price competition is assumed when dealing with pre-merger optimal location choice, whereas optimal post-merger relocation is studied in a spatial Cournot framework. A short reminder explains these two different strands. Internal profitability is hardly questioned under price competition, thanks to strategic

[30] Outside the spatial context, the potential of mergers to alter investment choices is recognized - Gatsios and Karp (1992) consider a duopoly and show that the levels of investment chosen with anticipation of merger are different from those chosen without.

complementarity, so location choices in anticipation of merger aim to further increase merger profitability by reducing the outsiders' free-riding. In contrast, post-merger relocation generating sufficient cost differentials appears as a necessary condition for Cournot competitors to enable merger profitability in the first place.

1.3.1 Location choice in anticipation of merger

The idea that location choice before merger may increase merger profitability by reducing free-riding was tackled by Rothschild et al. (2000) and Heywood et al. (2001) for Bertrand spatial competitors within a triopoly and then in the general case respectively. Rothschild et al. (2000) obtain that depending on the sharing rule w.r.t. the post-merger profit, insiders can gain more than the outsider by moving farther away from the latter, so as to reduce free-riding. The paper reminds however that in order to be profitable, a merger must involve adjacent firms, therefore in this triopoly framework the outsider necessarily holds the 'border' position. The n-firm oligopoly considered by Heywood et al. (2001) allows in contrast to consider 'interior' mergers, i.e. facing outsiders on both sides, who may not all equally benefit from the merger externality. Outsiders may experience a fall in their profits only after a 'corner' merger[31] (as in the triopoly case), while they always benefit from an 'interior' one, which can actually be either internally profitable or hurting rivals, but never both simultaneously.

A second important point concerning models dealing with location chosen in anticipation of merger is that the spatial pattern thus obtained is actually not efficient, i.e. transport cost are not minimized. In contrast, when the location decision follows the merger, the insiders always locate so as to minimize transport cost, because this strategy maximizes joint profit. This second point incidentally reminds that mergers in spatial markets exhibit other adverse consumer and welfare effects than just price increases.

The first paper to have explicitly allowed for pre-merger location choice in anticipation of merger within a spatial price discrimination model is Gupta et al. (1997), who consid-

[31] Quite intuitively, this is the only case where a future insider can move on one side without losing market shares to the excluded rivals, but this 'corner' case is relevant only for markets well approximated by the linear space representation.

ered a duopoly on Hotelling's unit market. Without foresight of merger, firms locate at the quartiles[32], which no longer holds when a firm anticipates taking over its rival: as the probability that a particular firm will be the acquiring one increases, it locates ever closer to the center of the market, whereas its target may move towards the market border for high enough probabilities (the symmetry is preserved if firms anticipate the take-over with equal probability). In any case, the resulting locations do not minimize transport costs for consumers[33]. The same incentive to optimally react beforehand in anticipation of the changes brought by the merger is present in a different though related spatial framework - Ecer (2005) showed in a Hotelling-type shopping model that when anticipating a stricter control of their merger, duopolists increase product differentiation not through location choices, but by the choice of transport cost per distance. This eventually allows firms to sustain higher equilibrium prices, and therefore decreases consumer surplus both directly and indirectly.

1.3.2 Post-merger repositioning

Choosing locations after merger necessarily improves locational efficiency, and thereby possibly the merger profitability. To explore the incentive for repositioning/relocation and its consequences in terms of merger assessment, we review next the spatial literature dealing with the assumption of multi-store/-product competition. This is so because a merger gives rise *a priori* to a multi-unit entity, operating from several locations or offering several jointly-owned brands.

Further insights from location theory: multi-store/product competition

The now vast literature on spatial competition with location choice mainly assumes that each firms can set up only one store, which is presumably done to avoid supplementary analytical complexity. Yet, the theory of spatial competition gains in relevance whenever addressing multi-store/product competition, since it is common practice for firms in the

[32] Following Hurter and Lederer (1985), spatial price discrimination with simultaneous market entry and no opportunity for merger yields the symmetric equally-spaced transport minimizing locations along the segment.

[33] This was also true for Rothschild et al. (2000) and Heywood et al. (2001).

real world to open several retail shops in a given neighbourhood[34]. Similarly, in terms of differentiated products, by selling several products in the same market, firms can tailor them to different horizontal segments of the market, and accordingly charge higher prices. Furthermore, this technical simplification is often made at the cost of implying that results extend over from the single-store case, which need not necessarily be true. Except for divisionalization (i.e. setting up independent divisions) which rules out centralized decision-making, when a firm has several stores (or, equivalently, product brands), each store's behaviour affects the decisions of all other stores on the market, including those owned by the same firm. Therefore each store cannot be simply viewed as an independent single-store entity, and results obtained with multi-store/product firms are likely to differ from those obtained without[35].

Despite compelling every day observations, the literature dealing with strategic location choice in the multi-store/product framework is not vast, possibly on account of the earliest theoretical results obtained. In the context of Hotelling's model with linear transport cost, Teitz (1968) points out that a Nash location equilibrium is not consistent with multi-store competition. The nonexistence problem is as usual related to the linearity of transport cost combined with mill f.o.b. pricing, but even with quadratic transport cost, a similarly puzzling finding is obtained by Martinez-Giralt and Neven (1988), who study in this setting the two-stage location-price game between two-store duopolists, both on the linear and the circular markets. They find that in equilibrium both firms cluster own affiliates at a unique location. The incentive to segment the market and improve consumer surplus extraction by differentiating own products actually intensifies price competition, so in equilibrium firms do not proliferate. Janssen et al. (2003) revisit the mill-pricing location-price duopoly game on the circular city, with general consumer distribution and transport cost functions. By adding a second product differentiation dimension under

[34] Retail companies such as fast-food restaurants, supermarkets, gasoline stations, clothing shops, department stores, hotels, travel agencies or bookstores generally operate a chain of outlets.

[35] In the context of retailing, Ghosh and McLafferty (1987, Chapter 6) argue that the traditional methods of site selection with single-outlet firms are inadequate to analyze location decisions of multi-outlet retail firms. They claim that the analysis of multi-outlet retailers requires systematic evaluation of the impact of each store on the entire network.

the form of heterogenous consumer preferences across chains of stores, they show that a pure-strategy equilibrium with distinct outlets does exist. Their result is however striking, to the extent that the location decisions of multi-store firms are entirely independent of each other (they are in dominant strategies), and are basically function of consumer distribution only. Stores (rival or not) never agglomerate, and their number has no influence on the pricing decision[36]. To sum up, under standard Bertrand mill pricing competition, both on the linear and circular markets, each firm clusters own stores and rival outlets never agglomerate, so as to relax competition.

Under Cournot spatial competition, the outcome of spatial dispersion of own affiliates obtains instead. Within a shipping homogenous-product model, when a firm opens several facilities, they necessarily operate from distinct locations due to the intra-firm strategic substitutability effect, and total profit is maximized by serving each local market only from that outlet which has the lowest unit delivered cost at that market. However, rival outlet agglomeration is possible in such a framework.

Sarkar et al. (1997) obtained, in the case of spatially separated markets in a discontinuous space (a network), possible partial agglomeration of rival outlets at discrete points in space, which are always some vertices of the network and never intermediary locations. For the continuous space case (contiguous markets), the location equilibrium for an arbitrary number of firms and stores was thoroughly worked out for the linear bounded market by Pal and Sarkar (2002). The model shows that the problem is less complex than expected, since it can be approximated by a lot simpler one, in which a firm behaves as a monopolist when locating its stores. A firm's equilibrium locations converge to the monopoly pattern as demand grows larger, and when firms have the same number of stores, rival outlets cluster at finitely many discrete points which coincide with a firm's monopoly locations. The location equilibrium is always unique and symmetric with respect to the market center. Both are due to the border effect on the segment market, which imposes for each individual store a unique quantity-median location, basically determined with respect to

[36] This may seem counterintuitive, but is explained by the fact that in a mill pricing model, competition is localized: not all outlets compete with each other, but actually only with neighbouring outlets of the competing chain.

other stores' respective locations and the exogenous market borders.

Given that the quantity-median is double[37] for each store, the circular city framework greatly complicates the location choice for Cournot multi-store firms. It does not come as a surprise that only simple particular cases have been worked out, and the general framework with an arbitrary number of firms and stores is considered yet intractable. Chamorro-Rivas (2000) studied the two-plant duopoly, and found that all stores are evenly spaced with affiliates paired and rival outlets interlacing on the circumference. Since product homogeneity implies maximum dispersion for a firm's stores, by the same token inter-firm substitutability induces rival stores' dispersion. Still, the equilibrium may not be unique on the circle market, and Cosnita (2005) made the point that the equal number of stores for the two competitors plays an important role. Indeed, competition between one single-store firm and one two-store firm yields two equilibrium patterns: either the single-plant firm clusters with one of the affiliate diametrically opposite to the other affiliate, or the former locates mid-distance between the two rival outlets. Similarly, the equilibrium for one two-store firm facing two single-store firms involves two diametrical pairs: either equidistantly in complete dispersion, or collapsing at the opposite ends of the same diameter.

At any rate, the location patterns obtained under spatial quantity competition are clearly consistent not only with commonly observed firm/store clustering, but also with the basic intuitions that a store's location should take into account the location of rival firms/stores. From a more general standpoint, spatial models in their multi-plant or multi-product versions exhibit at least the convenient advantage of modelling post-merger competition in a more realistic way, given that any merger leads to a multi-store/product entity. The spatial framework can therefore be used to consistently answer questions such as: between which brands in a market a merger is most likely to occur, which are the likely changes in terms of product choice/design following the merger, which, if any of the affiliate stores/products is likely to be shut down afterwards, or where a plant might be relocated after the merger.

[37] On the circle, if a given location satisfies the quantity-median property for a store, so does its diametrically opposite location.

Merger analysis and antitrust issues with post-merger repositioning

As already mentioned, choosing locations after merger improves locational efficiency. Gandhi et al. (2005) study mergers between firms competing in a Hotelling-type framework by simultaneously choosing prices and locations. They find that the merged firm moves its two products away from each other to reduce cannibalization, whereas outsiders move theirs in between the insiders' brands. Gandhi et al. (2005) conclude that post-merger repositioning increases product variety[38]. This benefits consumers, since by decreasing substitutability between merging varieties the post-merger price increase is mitigated. However, price competition is generally softened throughout the market, since all varieties are more dispersed.

The outcomes of relocation such as improved locational efficiency, and lower product substitutability (increased variety) or, equivalently, less spatial agglomeration following the merger, are equally obtained in the case of Cournot shipping model. The important difference from the spatial Bertrand mergers is that relocation can solve the profitability paradox of Cournot mergers, for which the issue of merger rationale is consequently more challenging.

With fixed locations, Norman and Pepall (1998) proved that the merger paradox still occurs at each separate local market, and that a sufficient cost heterogeneity between partners is a necessary condition to achieve internal profitability. Endogenizing post-merger location choice took the analysis one step further, to the extent that supplementary cost savings can obtain in this case. The nonspatial studies have put down the sources of the paradox to the combination of strategic substitutability and the inability of insiders to credibly commit to exploiting the potential bigger size of their association, and have suggested various possible solutions. Besides the strategic complementarity, efficiency gains from cost savings or a credible commitment not to decrease output after merger[39] have been thus suggested. The latter have been explicitly assumed in the standard shipping

[38] See Berry and Waldfogel (2001) for an econometrical analysis supporting the outcome of increased product variety due to merger on the linear market.

[39] See Daughety (1990), who changes the insiders' behaviour to Stackelberg leadership to show that commitment is essential for merger profitability.

Cournot linear model retained by Norman and Pepall (2000), who argue that location can be a key factor allowing the merger to lead to a bigger and better firm: competitors have different location advantages in serving the set of spatially separated markets, hence a bilateral merger does not shut down one of the outlets, but instead can coordinate their location decisions, so as to become a bigger entity, better adjusted to consumer locations. The pre-merger market equilibrium has all firms clustered at the market center, as shown by Anderson and Neven (1991). After merger, the two insiders are assumed to act as Stackelberg leaders in location choice: whereas rivals still optimally cluster at the segment mid-point, affiliates migrate symmetrically towards the market borders due to intra-firm strategic substitutability, thus minimizing total transport cost and acquiring a comparative locational advantage over rivals w.r.t. the distant demand located at the segment ends. The market shares gained over this 'captive' demand offset the loss of market shares over central locations, and the merger is shown to be profitable provided that the initial market contain less than nine firms.

It would appear therefore that the behavioural asymmetry gives rise to enough cost savings through relocation[40] to allow mergers to become profitable. The result is questioned though by Cosnita (2005), and shown instead to crucially depend on the linear space assumption and the ensuing border effects.

Norman and Pepall (2000) acknowledge that the post-merger equilibrium with insiders acting as a Stackelberg leader in location choice is strictly equivalent to the simultaneous location game where the merged entity makes a centralized location decision for its two outlets. This approach is applied by Cosnita (2005) based on unchanged assumptions save one, the linear space. As a result, bilateral Cournot mergers in the circular city are shown to be unprofitable if the initial market contains at least four competitors. In contrast to the linear model, the analysis is complicated by the fact that the post-merger spatial equilibrium is not unique. The profitability of the merger to duopoly is explained by the fact that the two insiders face competition on one side only: some captive demand is still

[40] In their opposite context, Rothschild et al. (2000) claim that the profitability paradox does not arise in 'spatial' markets with delivered prices competition, because by committing to their locations in advance and retaining them after merger, firms are able to ensure an output level which makes the merger profitable.

available at locations between their respective positions. In turn, if the merged entity competes against two outsiders, both resulting location equilibria have each affiliate face competitors on both sides. To put it short, even though relocation does yield delivery cost savings for the merged entity, the circular framework symmetry no longer affords the opportunity of capturing some captive demand, so the insiders can no longer put to profit this locational advantage. This is actually consistent with a corollary of Deneckere and Davidson (1985), according to which in markets with symmetric intensity of competition the incentives to profitably merge are considerably lower.

Besides the improved location efficiency, the bilateral Cournot mergers on the linear city studied by Norman and Pepall (2000) necessarily increase market concentration and reduce competitive pressure at each local market, with the result that prices rise for most consumers (actually, the only consumes for which prices fall are those located towards the market borders, closest to the two affiliates, but overall consumer surplus falls). Yet, and in contrast to nonspatial analyses, the increased profit for both insiders and outsiders, together with the improved locational efficiency, are almost always sufficient to offset the consumer surplus-reducing effect and increase overall welfare (the only exception occurs for the triopoly case, where market concentration is already so high before merger that the competition-reducing effect can only be overwhelming).

To prevent and contain such competition-adverse effects, merger control authorities may resort to remedial measures - typically, in the case of horizontal mergers, under the form of divestiture injunctions (mandatory asset sales) - meant to restore market competition and prevent a price raise. Cosnita (2006) proposes an equilibrium analysis[41] w.r.t. spatial mergers, divestitures and their competitive effects

The first purpose of the Cosnita (2006) is to compare the incentives for merger and divisionalization in a linear shipping Cournot setting (the same as Norman and Pepall (2000) actually). Basic insight from the nonspatial analyses was that spinning off is profitable when merging is not[42], so they are viewed as mutually exclusive business strategies. Cosnita (2006) argues instead that although merger is profitable, subsequent division-

[41] Meaning based on location equilibria both before and after merger and/or divestiture.

[42] See Polasky (1992) and Baye et al. (1996) for explicit analyses of divisionalization incentives

alization can be even more, provided it only involves partial spin-off (i.e. establishing multi-store affiliates). In the linear framework retained, this sequence of strategies makes the best of both: the merger yields transport cost efficiency gains and a locational advantage, whereas by divisionalization the merged entity credibly commits to maintaining a high output. This overall profitability comparison still holds even if the initial merger is not profitable, which incidentally suggest a possible rationale for apparently unprofitable mergers (merge so as to better divisionalize afterwards and increase profits). The merger control insight in terms of divestiture effects is provided by a possible interpretation of the spatial outcome obtained after merger and divisionalization. Cosnita (2006) shows that the ultimate location pattern coincides with that following a mandatory asset sale to a new entrant. Such a measure is rendered necessary by the merger's adverse price effect, and is effective, inasmuch as the overall consumer surplus increases after divestiture. In this model, the credit of the spatial setting is finally threefold: to provide a consistent framework for an equilibrium analysis of both merger and divisionalization, to identify the markets where the adverse price effects occur through the equilibrium spatial analysis, and lastly, to illustrate a situation where despite being effective, a post-merger divestiture can increase merger profitability.

1.4 Concluding remarks

The purpose of this review of the literature dealing with horizontal mergers in a spatial framework was to stress that location, and space in general, are important for better seizing the motivations for and the outcome of market concentration. The following two chapters attempt to contribute to this topic - they are motivated by the profitability issue of horizontal mergers in a spatial setting. Chapter 2 presents in detail the model and results of Cosnita (2005), so in short it proposes a complementary profitability analysis to that performed by Norman and Pepall (2000). Chapter 3, containing the analysis in Cosnita (2006), examines in turn merger profitability in relation with another widely-used corporate strategy, divisionalization.

Chapter 2

Horizontal mergers in the circular city: Location properties and profitability analysis

Straight lines are quite matter-of-fact
If you know how to add and subtract.
But when it's circles in question
I have a suggestion:
Try not to forget the diameters.

(Anonymous)

This chapter builds on Cosnita (2005) "Horizontal mergers in the circular city: a note." Economics Bulletin, Vol. 12, No. 7 p. 1-10.

2.1 Introduction

As the recurrent merger waves recall, mergers and acquisitions (M&As) are extensively common as corporate strategies. Arguably, they are motivated by the higher expected returns they yield as compared with alternative strategies. To put it short (as a rather recent Wall Street Journal article does[1]), acquiring a new company is a lot easier than improving operations at your own. It is far easier and cheaper to acquire existing brand and outlets than to build new units from scratch. Exploiting a product that someone else has made by means of marketing, sales, and distribution efforts is a lot less painful than finding ways to make serious and effective internal changes. After all, traditional brands have already captured the loyalty (and mind space) of consumers in a target market. So most companies would rather just buy another one, which is an ego-gratifying and relatively straightforward business move.

And so most companies would do, if it were not for antitrust regulations. The latter were (sooner or later) adopted world-wide, in acknowledgement of the fact that private and social incentives for market concentration need not and often do not coincide, and for the explicit purpose of preventing the anticompetitive M&As and their negative consequences. To do so, merger control has gradually taken a 'more economic approach', which means increasing reliance on quantitative methods of analysis as well industrial economics models.

The problem with the theory of horizontal mergers is that it can make some puzzling predictions in terms of merger performance: according to both Cournot and Bertrand models, in the absence of market entry outsider firms benefit more from the merger than the merging partners[2] (which, incidentally, raises the question of why rivals protest to competition authorities against mergers). This is just part of the so-called merger profitability paradox - depending on the underlying assumption on market competition, the merger itself may prove utterly unprofitable [3].

[1] "Bosses Prefer Buying Businesses To Building Them", February 17, 2005

[2] This free-riding effect was pinned down by Stigler (1950).

[3] This questions the internal rationality of mergers that occur despite their apparent unprofitability - see Ravenscraft and Scherer (1987) and Banerjee and Eckard (1998) for empirical studies concluding on the poor performance of M&As. Different explanations were proposed to this puzzle, and the next chapter will dwell on this literature and to a certain extent will attempt to contribute to it.

2.1.1 Related literature

The profitability paradox of Cournot horizontal mergers is particularly associated with the work of Salant et al. (1983)[4]. For the linear, symmetric, homogenous good, simultaneous game, they show that mergers are not profitable unless they concentrate at least 80% of the market. The explanation lies with the combination of three assumptions: identical constant marginal costs, strategic substitutability and simultaneous output decisions. The merger creates a coalition between the insiders, who henceforth coordinate output decisions to maximize joint profit. To do so, the combined production of partners falls (so as to push up the market price). Given the constant marginal cost assumption, the merged entity shrinks to end up looking like any other firm in the industry. Finally, quantities being strategic substitutes, this triggers an output expansion on behalf of rivals. Still, overall production falls, and price goes up, but not enough to compensate the decrease in the combined market share of insiders. As a result, the latter experience a profit loss.

Merger profitability is restored by replacing the assumptions causing the paradox. Price competition with differentiated products ensures strategic complementarity[5], so a price increase by the insiders is matched by a 'soft' reply on behalf of the outsiders, i.e. a similar price increase. Deneckere and Davidson (1985) show thus that mergers are profitable within a Bertrand industry producing symmetrically differentiated varieties, and Levy and Reitzes (1992) and Reitzes and Levy (1995) make use of the spatial setting (both models use the circular city representation for the spatial differentiation) to show that this holds equally with asymmetric product differentiation. Nevertheless, strategic substitutability would be less troublesome if the insiders' profit maximization strategy were to increase output. This would be the case if the merger gave rise to cost savings[6], so that the merging partners could benefit from a low enough post-merger unit product cost to guarantee them a market share increase[7]. By the same token, if the output decisions

[4] See also Szidarovsky and Yakowitz (1982) and Davidson and Deneckere (1985).

[5] Gaudet and Salant (1992) signal the importance of strategic complementarity for the paradox.

[6] The merger may be profitable provided the unit cost depend on a "tangible asset that the merged firm acquires[...]which increases the output it can produce at a given average cost" - Perry and Porter (1985, p.226).

[7] Farrell and Shapiro (1990,a) coined the term 'synergy' for such substantial efficiency gains that take

were actually not simultaneous, but instead the insiders enjoyed a first-mover advantage, then this Stackelberg leadership would ensure an output increase and thereby merger profitability (Daughety (1990)).

The problem with these two last solutions of the paradox is that the frameworks considered should some way or another account for the origin of those synergies (endogenous?) or the change of behaviour (the precise mechanism by which any firm acquires the leadership is not really specified). The spatial setting appeared likely to fit these conditions. As Norman and Pepall (2000, p.668) put it, "location is a key factor underlying why a merger can lead to a bigger and better firm".

To start with, McAffee et al. (1992) made the point that in a standard[8] shipping Cournot model, the distance induces a marginal delivery cost asymmetry between the different firms at any location/sale point in the market. This cost differential allows the merged firm to keep open both outlets (in contrast with the non spatial model, where it shrinks to the size of an independent rival), so as to serve each market only from the closest plant. They argue that this efficient output reallocation allows the merged firm to potentially benefit from its bigger size. Between the lines one could read that the mere introduction of space in the model solved the paradox by creating cost differences between the merger partners. Nevertheless, Norman and Pepall (1998) show that this is not enough to restore internal profitability, because spatial markets are segmented in a standard linear shipping model with quantity competition. Without arbitrage on behalf of consumers, independent Cournot equilibria obtain at each local market due to local constant returns to scale, and therefore the merger paradox is present on each of these spatially separated markets. Marginal delivery cost asymmetry is not sufficient to reverse the unprofitability result, and simple output reallocation between affiliates does not generate a sufficient cost advantage to the merged entity.

In turn, if post-merger *relocation* is allowed for, the delivery cost asymmetry can endogenously increase. After all, repositioning own brands or geographically reshaping

the combined cost function to lower levels than any of the pre-merger stand-alone costs.

[8] That is, simultaneous-move game with homogenous good and identical constant unit production and transport costs.

one's distribution network[9] are common business strategies. Norman and Pepall (2000) claim that Cournot horizontal mergers in shipping spatial linear models with homogeneous good can prove profitable if firms relocate. More precisely, they show that the endogenous location in the post-merger game can make a merger profitable if the *segment* market is sufficiently concentrated (no more than eight firms initially), provided that the insiders enjoy a first-mover advantage in location. The article actually argues that besides the endogenous location, it is the behavioral asymmetry between the insiders and the outsiders at this stage of the game that makes the merger profitable. To eliminate the incapacity of the merged entity to commit to a higher level of output in the post-merger game, Norman and Pepall (2000) model a Stackelberg-in-location stage before the quantity stage. The location first-mover advantage leads to a bigger and better firm, in as much as it enjoys a net absolute delivery cost advantage over its competitors w.r.t. a certain group of consumers who become its captive demand. Indeed, in their setting, the merger allows the two stores to coordinate their relocation choices in order to better adjust them to consumer locations. Given the initial spatial equilibrium, with all firms agglomerating at the market center (as shown by Anderson and Neven (1991)), the two affiliates move outwards toward the segment borders, and since the outsiders' optimal reply requires them to keep the central location, the merged entity will supply all consumers located between an outlet location and the segment endpoints with a lower delivery cost than the outsiders.

However, it turns out that this Stackelberg-in-location outcome can be replicated by a simultaneous relocation stage, on condition that the merged entity chooses two distinct locations for its affiliates[10] so as to prevent overlapping of their respective market areas. To sum up, the outcomes of the simultaneous location game and the sequential one coincide, despite the appealing interpretation of the location first-mover advantage as resulting from being 'bigger and better'. We conclude then that the location sequentiality assumption is

[9] The Wall Street Journal dated September 15, 2004, reminds that retailers can shape the (American) landscape in a 'positive' way, by adding new stores at top locations, but sometimes the opposite happens - according to the article ("Wal-Mart's Surge Leaves Dead Stores Behind"), Wal-Mart is known for dropping its 'big box' stores in order to open even bigger superstores elsewhere.

[10] Actually, the outcome of the simultaneous location subgame is basically a particular case of the general n-firm and m-store framework on the linear market, studied by Pal and Sarkar (2002).

not essential for the profitability result, and go on to look for an alternative explanation.

2.1.2 Purpose and relevance

In this chapter we examine whether the scope for profitable spatial horizontal mergers depends on the type of the underlying market shape assumption. Our work builds on the framework of Norman and Pepall (2000), up to the space circularity. We argue that the shape of the space is a supplementary yet essential condition to be taken into account, because the profitability result on the segment is due to the border effect present on such an exogenously bounded market, and not to the behavioral asymmetry assumption. Basically, since the merger profitability comes from the endogenous cost savings obtained through relocation, we argue that the extent to which these potential locational efficiency gains are put to profit by the merged entity depends entirely on the shape of the market.

We show in this chapter that mergers are more profitable and hence the merger incentives are higher in the linear city than in the circular one, and put this down to the fact that the segment is an asymmetric location structure as compared with the circle, where locations are homogenous.

More precisely, the existence of (exogenous) endpoints on the linear market makes it a continuum of heterogenous locations, to the extent that locations are 'differentiated' by the distance to the endpoints, which eventually makes the segment mid-point everybody's most preferred location. Indeed, Anderson and Neven (1991) show that (when firms are single-store and deliver throughout the segment market) the quantity-median location is the same and unique for all firms on the segment, its center, which explains the central agglomeration (minimum differentiation) outcome that prevails before merger. As a result, merger and relocation give the opportunity to reach at lower cost the distant demand, besides lowering the competitive pressure on the mid-segment location. By moving away from the centre of the segment, the two merged affiliates minimize total transport and enjoy locational efficiency gains, besides optimally reallocating output between them. These cost advantages are put to profit precisely because they apply to 'distant' demand, which remains 'distant' for all other firms in the industry, since the latter are still located at the market centre. To sum up, relocation makes merger profitable because outsiders' central

agglomeration is a dominant strategy on the linear market, with or without merger.

In turn, the circular market is a continuum of homogenous locations, there is no single median point (or median consumer, as Horstmann and Slivinski (1985) put it). All locations are *a priori* alike, and they can all potentially satisfy the quantity median property, it all depends on competitors' locations. Lack of a unique most-preferred location makes the competition effect dominant, and firms never agglomerate at the same location on the circle so as to reduce competitive pressure[11], as was shown by Shimizu and Matsumura (2003). Starting from such a spatial pattern, we show that merger and relocation actually reduce spatial dispersion of outlets, so basically post-merger competition is keener as compared with the segment market. As a result, it would take a larger increase in market power to make the merger profitable, which actually happens only when firms merge to form a duopoly. In this case, insiders can benefit from the captive demand at the local markets between their respective locations, to the extent that these markets are 'distant' and 'isolated' with respect to the (unique) outsider. In contrast, a merger to triopoly has both affiliates facing outsiders competition on both sides, without any captive demand available whatsoever, because in the subsequent relocation stage outsiders do not cluster together as on the segment market, but on the contrary disperse. This is basically the crux of the problem, and the essential difference w.r.t. the linear case: insiders' (efficient, though) relocation no longer guarantees captive demand, because the lack of exogenous market borders allows rivals to spread out and cover all local markets at competitive delivery costs.

In short, we show that despite relocation, mergers on the circle become unprofitable much earlier, i.e. starting with four firms on the market. Our model examines the cases of merger to duopoly and triopoly in detail, to stress that a certain degree of asymmetry or heterogeneity on the market (of which merged firms may take advantage of) is necessary to have sufficient incentives to merge.

Incidentally, this recalls the importance of the particular assumption on market shape underlying the basic model and its conclusions. Spatial models are particularly known for their sensibility to assumption changes - for instance, complete agglomeration under spatial

[11] Strategic substitutability is important for this dispersion result - see chapter 1 for details.

Cournot competition relies on the market shape and product differentiation assumptions[12]. We bring forward the possibility for the profitability of spatial mergers to depend likewise on an assumption underlying the spatial framework used.

After all, even if a substantial bulk of the literature on spatial competition builds on the linear market hypothesis, certain situations are better mirrored by the circular city framework. For instance, firms locating on the circle approximate department stores in circular towns spreading around lakes, or shopping malls within suburban belt-ways circling traffic-jammed cities, as well as television networks choosing time slots for their programmes around the dial clock, or rival airlines choosing the arrival and departure times for their flights. On the other hand, the circular city paradigm can equally represent a given set of consumers with particular preferences defined over a set of goods in an abstract characteristics space. If the linear representation applies to single-peaked consumer's preferences (see Black (1948) for this well-known result in social choice literature), no such analogy is available for preferences represented by the circular model. Actually, the linear paradigm is characterized by the presence of a unique median consumer, which does not hold on the circle[13]. Horstmann and Slivinski (1985) also note that consumer preference restrictions imply in the case of the circular representation that products which are no individual's least preferred good simply do not exist (they would be located inside the circumference), whereas they abound in the linearly representable structure. In other words, *all* varieties on the circle are someone's most preferred commodity and someone else's least preferred commodity (which is not the case for varieties on the segment). One might therefore venture to conclude as follows on the choice between the circular and the linear models: the former, circular paradigm, seems more appropriate for global markets,

[12] To obtain spatial clustering, the agglomeration force(s) must dominate the competition-driven dispersion force. The exogenous market borders in the linear case push firms together, basically through a market size effect, because the central location guarantees the profit-maximizing spatial pattern for sales. Product differentiation can act either as an agglomeration or a dispersion force: product substitutability (complementarity) implies that own delivered output is lower (higher) at a rival's location.

[13] Given any pair of goods over which consumers' preferences are defined, on the circle there are always two such median consumers indifferent between the two commodities, whose preference orderings are exactly opposite one another. See Horstmann and Slivinski (1985) for more details on this median consumer and consumers' preferences represented by location models.

where border effects are virtually inexistent, and where different varieties may more easily satisfy the above condition that each of them is simultaneously a most preferred and least preferred brand. The latter, linear case, can approximate regional or national markets, where border effects may be more powerful. Finally, and in line with the main point of our merger analysis, if the existence of the market border effect is interpreted as giving rise to opportunities for obtaining some captive demand (exploiting commercial niches, for instance), then the circular framework might be more useful for modelling steady, mature (even declining) markets, where such opportunities have disappeared, whereas the linear setting would represent expanding markets, where such niches still exist.

We go on next to our analysis of horizontal mergers in the circular city. The chapter is organized as follows: the basic model is presented before discussing mergers to duopoly and triopoly. Each time location equilibria before merger are examined first, then the post-merger spatial pattern is identified, and finally the profitability analysis is performed. The (quite extensive) technical computations are summarized and grouped in Appendix A.

2.2 Model

The model we use is from Norman and Pepall (2000), except for the shape of the market.

There is a circular market of length 1 where infinitely many consumers lie uniformly. Identical single-store firms, equally located in $[0,1]$, produce a homogeneous good with the same technology characterized by constant marginal costs, normalized to zero. Firm's i location is denoted by x_i. At any consumer location x on the circle, demand is given by $p(x) = a - Q(x)$, $a > 0$, where $p(x)$ is the product price at that location and $Q(x)$ is the total output supplied at x. Firms incur transport costs $t\,|x - x_i|$, linear in distance and quantity, in order to ship output to consumers. t is a positive constant, and since the transport cost parameter enters as a multiple in the profits expression, for our profitability analysis we will assume $t = 1$ without loss of generality[14]. Equivalently, let a be the

[14] The consumer reservation price is the central parameter for the profitability of a merger and it cannot be further normalized - see Norman and Peppal (2000).

transport-cost adjusted reservation price[15]. The norm stands for the shorter distance of the two possible ways to ship goods along the circumference from the firm's location x_i to the consumer market located at x. Consumers have a prohibitive costly transport cost, preventing arbitrage, so firms can and will price discriminate across the set of spatially differentiated markets.

Starting from an initial location equilibrium, two firms merge (an exogenous decision). The firms engage in the following post-merger location-quantity competition. Following Norman and Pepall (1998, 2000), we remind that relocation is a necessary (though not sufficient, as we show in this chapter) condition for Cournot horizontal concentration to be profitable. In the first stage, each firm simultaneously decides where on the perimeter to locate. After observing the rivals' locations, in the second stage each firm simultaneously chooses its output level at every point (market) in the continuum [0, 1] as to maximize its profit. There are no set-up or (re)location costs[16], and there is neither entry on nor exit from the market (each firm supplies a positive quantity at every local market).

To examine merger profitability, this two-stage post-merger game needs to be solved. This is done by backward induction, and the equilibrium concept used is subgame perfect Nash equilibrium. Thus the second-stage subgames and the local Cournot competition are examined first.

General resolution of the spatial Cournot-Nash equilibrium

Since marginal production cost is constant and arbitrage among the consumers is not feasible, quantities set at different points by the same firm are strategically independent. Therefore, the second stage Cournot equilibrium can be characterized by a set of independent Cournot equilibria, one for each market $x \in [0, 1]$.

Generally denoting by x_i a firm's location, $x_i \in [0, 1]$, and by $q_i(x)$ its output at a given location x, under the above assumptions, at each point $x \in [0, 1]$ firm $i, i = 1, n$

[15] In the product-differentiation analogy of this model, a can be interpreted as an inverse measure of the extent to which consumer tastes are strongly localized.

[16] We make this assumption (a standard one in the literature on strategic location in Cournot oligopoly) for the sake of a straightforward comparison with the results of Norman and Pepall (2000), who equally assume costless (re)location.

makes profit given by

$$\pi_i(q_i(x), q_{-i}(x); x) = \left[a - t\,|x_i - x| - q_i(x) - \sum_{j \neq i}^{n-1} q_j(x) \right] q_i(x) \tag{2.1}$$

Taking first order conditions to solve for the unique Cournot equilibrium yields

$$q_i^*(x) = \frac{1}{n+1} \left[a + \sum_{j \neq i}^{n-1} t\,|x_j - x| - nt\,|x_i - x| \right] \tag{2.2}$$

Taking into account that aggregate supply at x writes $Q^*(x) = \frac{1}{n+1}\left(na - \sum_1^n t\,|x_j - x|\right)$, the individual profit function at x can be rewritten as

$$\pi_i^*(x) = [q_i^*(x)]^2 \tag{2.3}$$

which is standard Cournot outcome given the assumptions made. Finally, firm's i total (i.e. over the whole set of spatial markets) profit function is

$$\Pi_i(x_i, x_{-i}) = \int_0^1 \pi_i^*(x_i, x_{-i}; x)dx \tag{2.4}$$

At the first stage, each firm maximizes its own total profit function in own location. The outcome of this simultaneous subgame in locations represents the spatial equilibrium.

2.2.1 Merger to duopoly

The initial spatial competition on the circle market involves three single-store firms. Two among the three firms merge. In the resulting duopoly market the two-store merged entity faces a single-store outsider. In contrast with the linear market, the merger to duopoly on the circle exhibits a lower profitability range and multiple location equilibria.

Pre-merger equilibrium

The profitability analysis necessarily begins by establishing the pre-merger global profit for merging firms. And since the starting point of the merger game is also a location equilibrium, the pre-merger profit results from the latter.

We do not need to explicitly solve the pre-merger location-quantity game in order to identify the pre-merger spatial equilibrium. Instead, we can (simply) make use of the analysis of Shimizu and Matsumura (2003).

The first important point stems from Proposition 1 in Shimizu and Matsumura (2003), stating that complete agglomeration cannot be an equilibrium on the circular market, given all the above assumptions. Consequently, the spatial equilibrium for three firms necessarily involves either a spatial pattern with three distinct locations, or one with only two distinct locations.

According to Proposition 3 in Shimizu and Matsumura (2003), for an odd number of firms competing on the circular market, the situation where half plus one firms locate at 0 and the others at 1/2 (going clockwise on the circumference) is an equilibrium. Therefore, a first pre-merger equilibrium involves two firms clustering at 0 and the third at 1/2. We call this the 'diametrical' pattern.

Finally, Proposition 4 in Shimizu and Matsumura (2003) basically implies that the equidistant spatial pattern is always an equilibrium, and Gupta et al. (2004) give the general formulation for this result. Consequently, the second pre-merger spatial equilibrium involves one firm locating at 0, the second at 1/3 and the third at 2/3. We call this the 'equidistant' pattern.

The following diagram presents the two alternative pre-merger spatial equilibria

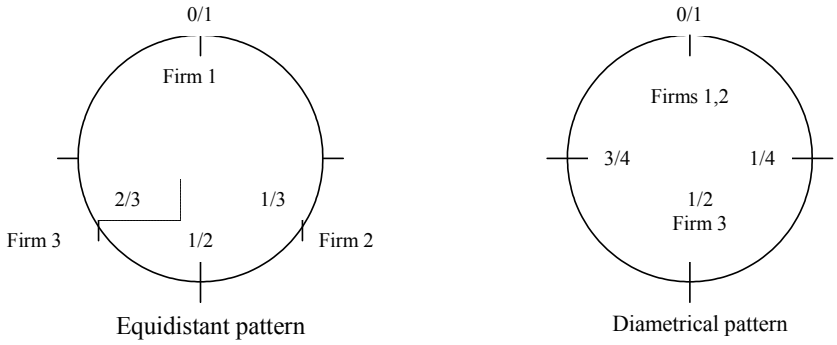


Figure 2.1: Location equilibria before merger to duopoly

Due to the perfect symmetry, in the equidistant pattern the three firms make the same profit, which writes:

$$\Pi^{(3)}\left[equid\right]=\frac{1}{16}\left\{\begin{array}{c}\int_0^{1/6}\left[a+(1/3+x)+(1/3-x)-3(x-0)\right]^2dx+\\ \int_{1/6}^{1/3}\left[a+(2/3-x)+(1/3-x)-3(x-0)\right]^2dx+\\ \int_{1/2}^{2/3}\left[a+(2/3-x)+(x-1/3)-3(1-x)\right]^2dx+\\ \int_{2/3}^{5/6}\left[a+(x-2/3)+(x-1/3)-3(1-x)\right]^2dx+\\ \int_{5/6}^{1}\left[a+(x-2/3)+(1-x+1/3)-3(1-x)\right]^2dx\end{array}\right\}=\frac{1}{16}a^2-\frac{1}{32}a+\frac{127}{5184} \tag{2.5}$$

where the superscript number between brackets reminds the number of firms on the market.

In turn, the diametrical pattern yields different individual profits, depending whether the firm we consider locates at 0 (i.e. together with a rival) or at 1/2 (i.e. alone). The profit of a firm at 0/1 writes:

$$\Pi^{(3)}\left[diam;0/1\right]=\frac{1}{16}\left\{\begin{array}{c}\int_0^{1/2}\left[a+(1/2-x)+(x-0)-3(x-0)\right]^2dx+\\ \int_{1/2}^{1}\left[a+(x-1/2)+(1-x)-3(1-x)\right]^2dx\end{array}\right\}=\frac{1}{16}a^2-\frac{1}{32}a+\frac{1}{64} \tag{2.6}$$

whereas the profit of the (unique) firm locating at 1/2 writes:

$$\Pi^{(3)}\left[diam;1/2\right]=\frac{1}{16}\left\{\begin{array}{c}\int_0^{1/2}\left[a+2(x-0)-3(1/2-x)\right]^2dx+\\ \int_{1/2}^{1}\left[a+2(1-x)-3(x-1/2)\right]^2dx\end{array}\right\}=\frac{1}{16}a^2-\frac{1}{32}a+\frac{7}{192} \tag{2.7}$$

Basically, the two location equilibria before merger are not equivalent; we can order the profits: $\Pi^{(3)}\left[diam;0/1\right]<\Pi^{(3)}\left[equid\right]<\Pi^{(3)}\left[diam;1/2\right]$. In the diametrical case, the firm at 1/2 performs better than the other two firms, thanks to a lower degree of competition at its own location.

Post-merger equilibrium

Following the merger, the two-store merged entity faces a single-store outsider. In order to compute the optimal locations after merger, denote by z, $z\in[0,1/2]$, the location of the single-store firm, and by d and $1-d$ those of the two affiliates[17], where $d\in[0,1/2]$.

[17]Following Pal and Sarkar (2002), we know that the two affiliates will never share the same location. Moreover, on each side of an affiliate, its market area extends up to the midpoint

The equilibrium profits for the merged entity and the outsider, denoted by $\Pi^{(2)}_{merged}$ and $\Pi^{(2)}[z]$ respectively, (following the same superscript notation pattern as before merger) write as follows:

$$\Pi^{(2)}_{merged} = \frac{1}{9}\left\{\int_0^{1/2}[a+|z-x|-2|d-x|]^2\,dx + \int_{1/2}^{1}[a+|z-x|-2|1-d-x|]^2\,dx\right\} \tag{2.8}$$

$$\Pi^{(2)}[z] = \frac{1}{9}\left\{\int_0^{1/2}[a+|d-x|-2|z-x|]^2\,dx + \int_{1/2}^{1}[a+|1-d-x|-2|z-x|]^2\,dx\right\} \tag{2.9}$$

Depending on the relative position of the single-store outsider firm w.r.t. the two affiliates, the above profit expressions can take slightly different forms, because of the corresponding expressions of transport costs, therefore the discussion is divided in several cases:

case 1	$0 \leq z \leq d \leq 1/2 \leq z+1/2 \leq 1-d \leq 1$
case 2	$0 \leq z \leq d \leq 1/2 \leq 1-d \leq z+1/2 \leq 1$
case 3	$0 \leq d \leq z \leq 1/2 \leq 1-d \leq z+1/2 \leq 1$

The optimal locations result from the profits' maximization w.r.t. d and z respectively. Every time the First Order Conditions (FOCs) are taken on the explicit profit expressions, then the candidate locations are checked against the Second Order Conditions (SOCs). Appendix A presents the detailed computations, but the solutions obtained are the following:

case 1	$z=0,\ d=\frac{1}{2}-a+\frac{1}{4}\sqrt{(2-8a+16a^2)}$
case 2	$z=1/4,\ d=1/4$
case 3	$z=1/2,\ d=a-\frac{1}{4}\sqrt{(16a^2+2-8a)}$

Note that cases 1 and 3 yield strictly the same outcome, up to a half-circle rotation. In other words, (only) two equilibrium patterns turn up. Both cases 1 and 3 yield a spatial

between itself and the other affiliate. There is no market area overlapping, and basically each outlet supplies on half a circle. We can always denote the two midpoints by 0 and 1/2, for ease of computation and exposition, and without any loss of generality.

outcome as a degenerate segment, with the outsider at mid-distance between the two insiders[18]. We call this Type 1 equilibrium. In turn, case 2 yields a location equilibrium that could have been obtained on the linear market, with the two the affiliates locating as a two-store monopoly (i.e. diametrically), but with the outsider and one of the insiders sharing the same location. We call this Type 2 equilibrium. The following diagram presents these two patterns:

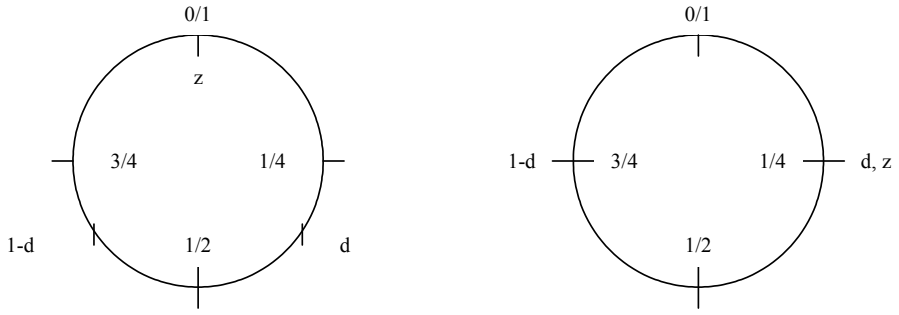


Figure 2.2: Location equilibria after merger to duopoly

Profitability analysis

Similarly to the pre-merger situation, the post-merger patterns are not equivalent in terms of profits firms make, with the merged firm performing better on the so-called degenerate segment. More precisely, evaluating the profit expression for the identified solutions of the location stage, the following obtains (see details in Appendix A):

Type 1 pattern	$\Pi^{(2)}_{merged}\left[type\ 1\right] = \frac{1}{9}\left(\begin{array}{c} -\frac{3}{2}a + \frac{1}{4} + 5a^2 + \frac{1}{6}\sqrt{(2-8a+16a^2)} - \\ \frac{2}{3}a\sqrt{(2-8a+16a^2)} + \frac{4}{3}a^2\sqrt{(2-8a+16a^2)} - \frac{16}{3}a^3 \end{array}\right)$
Type 2 pattern	$\Pi^{(2)}_{merged}\left[type\ 2\right] = \frac{1}{9}\left(a^2 + \frac{1}{24}\right)$

The last step of the profitability analysis is to compare these expression with those of the pre-merger profit, so as to be able to pin down the profitability range for the

[18] We make this parallel with the segment case because we actually obtain the very same result as that of Norman and Pepall (2000, p.672): their optimal location d at which an affiliate locates (measuring from 0 as the left-hand endpoint) is $d = \frac{1}{4} + \sqrt{\left(\frac{4v-1}{4(n-2)}\right)^2 + \frac{1}{16}} - \frac{4v-1}{4(n-2)}$. Evaluating this for $v = a$, and $n = 3$, one obtains $\sqrt{\frac{1}{8}\left(8a^2 - 4a + 1\right)} - a + \frac{1}{2} = \frac{1}{4}\sqrt{2}\sqrt{8a^2 - 4a + 1} - a + \frac{1}{2}$, q.e.d.

merger to duopoly. This is defined in terms of the demand parameter[19], so following Norman and Pepall (2000), we look for the range of maximum reservation price a such that all firms supply positive quantities throughout the set of local markets[20], and ensuring merger profitability. Table 2.1 summarizes this profit comparison, where $\Delta\Pi = \Pi^{(2)}_{merged} - \sum \Pi_{before}$, and Appendix A details the corresponding computations.

Table 2.1: Profit comparison for merger to duopoly

$\Delta\Pi =$	a∈( ] such that $\Delta\Pi \geq 0$
$\Pi^{(2)}_{merged}[type\ 1] - \sum \Pi$ equidistant firms	a∈(1.5, 3.6]
$\Pi^{(2)}_{merged}[type\ 2] - \sum \Pi$ equidistant firms	a∈(1.5, 3.61]
$\Pi^{(2)}_{merged}[type\ 1] - \sum \Pi$ diametrical firms (firms at 0 and 1/2)	a∈(1.5, 3.57]
$\Pi^{(2)}_{merged}[type\ 2] - \sum \Pi$ diametrical firms (firms at 0 and 1/2)	a∈(1.5, 3.53]
$\Pi^{(2)}_{merged}[type\ 1] - \sum \Pi$ common location firms (firms at 0)	a∈(1.5, 4.01]
$\Pi^{(2)}_{merged}[type\ 2] - \sum \Pi$ common location firms (firms at 0)	a∈(1.5, 4.023]

It is important to note that the profitability range is smaller on the circle as compared with the linear case[21] discussed by Norman and Pepall (2000), regardless of the case we look at.

The merger to duopoly is less profitable on the circle, because starting from less rivalry before, the merger leads to more competition afterwards, due to the location pattern that results from post-merger relocation. This is the opposite outcome to the linear case. The unique initial equilibrium on the segment had all firms in the middle (see Anderson and Neven (1991)), whereas on the circle, at most two firms share the same

[19] There is always an upper bound for spatial merger profitability, because as demand grows larger, firms tend to locate as a monopoly (see Pal and Sarkar (2002)), therefore the possible spatial efficiency gains obtained through merger and relocation become increasingly irrelevant, thereby making the merger unprofitable.

[20] This is $a \geq \frac{n \cdot t}{2}$ for circular markets, therefore here the lower bound for a is 1.5. The above general condition merely states that local market demand is sufficiently large w.r.t. to total delivery cost at that point to guarantee for *all* (n) firms positive delivered outputs. The maximum distance a firms rationally covers on the circle is $\frac{1}{2}$, and in our particular case $n = 3$ and $t = 1$.

[21] On the segment market, the (unique) profitability interval for the merger to duopoly was $(1.5, 4.4089]$ - see Norman and Pepall (2000, p.675).

location before merger, so initial individual profits are higher than on the segment[22]. By post-merger relocation on the linear market, the merged entity symmetrically moves its affiliates towards the endpoints, thus reducing competitive pressure at the center. In turn, on the circular market the merged firm either shares a location (and hence its location advantage) with the rival, or the latter is located half-distance between its stores. This is the pattern which allows a higher merger profitability, nevertheless the profitability range is smaller than on the segment, because of the lower captive demand. On the segment, the merged entity enjoys some captive demand between its stores and the endpoints, since the outsider remains located at the middle, and the exogenous market borders prevent any risk of cannibalization between the two affiliates. The captive demand effect still exists on the circle in the segment-like case, but is weaker precisely because the frontier between the market areas of the two affiliates is now endogenous, no longer fixed by endpoints. The two stores both face the outsider on one side of their market areas, but on the other they are in open competition with each other. This negative effect of owning two outlets was absent on the linear market, therefore merger profitability was higher.

2.2.2 Merger to triopoly

The next step of our proof that Cournot mergers are less profitable on the circle than on the segment market is to examine profitability of mergers to triopoly. We start again with the pre-merger location analysis and go on to determine the location post-merger equilibrium, so as to be able to compare profits before and after merger. This merger turns out to be unprofitable.

Pre-merger equilibrium

As in the previous section, to determine the pre-merger spatial market equilibrium there is no need to explicitly solve out for the equilibrium locations of four firms competing on the circular market. A qualitative analysis of the pre-merger situation is enough to

[22] This is straightforward: on the segment, the pre-merger individual profit of a firm in triopoly amounts to $2 \cdot \int_0^{1/2} \left(\frac{a-(1/2-x)}{4}\right)^2 dx = \frac{1}{16}a^2 - \frac{1}{32}a + \frac{1}{192}$. On the circle, the lowest pre-merger profit a firm makes is $\Pi_{0/1}=\frac{1}{16}a^2 - \frac{1}{32}a + \frac{1}{64}$,which is obviously higher.

establish all initial location equilibria.

Given that total agglomeration cannot be an equilibrium, the four-firm spatial pattern may *a priori* exhibit two, three or four *distinct* locations. Following Matsushima (2001,a), the even number of firms on the pre-merger market allows for a two-distinct-location equilibrium, with firms paired at the ends of a diameter. On the other hand, firms pairing at the ends of two distinct diameters is equally an equilibrium, as shown by Gupta et al. (2004).

Finally, it is straightforward to see that there can be no equilibrium involving three distinct locations. Due to the quantity-median property, with three firms dispersed on the circle, the fourth necessarily either clusters with, or locates diametrically opposite to one of them. In the first case, the two other firms have incentives to deviate to the diametrically opposite point, on account of the strategic substitutability, which eventually yields the two-distinct-location pattern. In the second case, as shown by Gupta et al. (2004), the best that two firms can do when the others are paired at the ends of a diameter is to equally pair up diametrically.

To sum up, a three-location pattern is unstable, hence is not an equilibrium, and there are (only) two pre-merger equilibrium patterns: two firms at 0 and the other two at 1/2, and each time a firm at the end of a diameter. The following figure presents them:

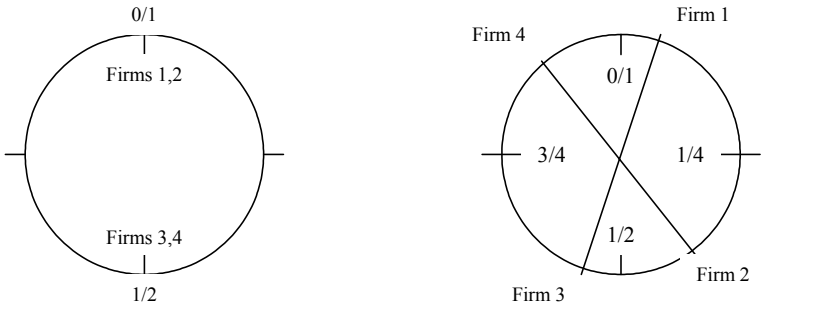


Figure 2.3: Location equilibria before merger to triopoly

From the firms' profits point of view, it is straightforward to show that both equilibria (with two and four distinct locations) are strictly equivalent - for ease of computation (so as to simplify to the maximum the transport cost expressions) we shall nevertheless use

two perpendicular diameters, without any loss of generality whatsoever.

The profit expression for any firm in the equidistant pattern is:

$$\Pi^{(4)}\left[equid\right]=\frac{1}{25}\left\{\begin{array}{c}\int_0^{1/4}\left[a+(1/4-x)+(1/2-x)+(x+1/4)-4x\right]^2dx+\\ \int_{1/4}^{1/2}\left[a+(x-1/4)+(1/2-x)+(3/4-x)-4x\right]^2dx+\\ \int_{1/2}^{3/4}\left[a+(x-1/4)+(x-1/2)+(3/4-x)-4(1-x)\right]^2dx+\\ \int_{3/4}^{1}\left[a+(1+1/4-x)+(x-1/2)+(x-3/4)-4(1-x)\right]^2dx\end{array}\right\}=\frac{\frac{7}{12}-\frac{1}{2}a+a^2}{25} \tag{2.10}$$

whereas the profit for any firm in the alternative, all-paired pattern writes:

$$\Pi^{(4)}\left[paired\right]=\frac{1}{25}\left\{\begin{array}{c}\int_0^{1/2}\left[a+x+2(1/2-x)-4x\right]^2dx+\\ \int_{1/2}^{1}\left[a+1-x+2(x-1/2)-4(1-x)\right]^2dx\end{array}\right\}=\frac{\frac{7}{12}-\frac{1}{2}a+a^2}{25} \tag{2.11}$$

Post-merger equilibrium

For the post-merger spatial pattern, involving one two-store merged entity and two single-store outsiders, no such qualitative analysis is available. To compute the post-merger equilibrium locations, denote again by d and $1-d$ the locations of the two affiliates, where $d\in(0,1/2)$, and by z and y those of the two outsiders. The profits to be maximized in locations write as follows:

$$\Pi^{(3)}_{merged}=\frac{1}{16}\left\{\begin{array}{c}\int_0^{1/2}\left[a+|y-x|+|z-x|-3\left|d-x\right|\right]^2dx\\ +\int_{1/2}^{1}\left[a+|y-x|+|z-x|-3\left|1-d-x\right|\right]^2dx\end{array}\right\} \tag{2.12}$$

$$\Pi^{(3)}\left[z\right]=\frac{1}{16}\left\{\begin{array}{c}\int_0^{1/2}\left[a+|y-x|+|d-x|-3\left|z-x\right|\right]^2dx\\ +\int_{1/2}^{1}\left[a+|y-x|+|1-d-x|-3\left|z-x\right|\right]^2dx\end{array}\right\} \tag{2.13}$$

$$\Pi^{(3)}\left[y\right]=\frac{1}{16}\left\{\begin{array}{c}\int_0^{1/2}\left[a+|z-x|+|d-x|-3\left|y-x\right|\right]^2dx\\ +\int_{1/2}^{1}\left[a+|z-x|+|1-d-x|-3\left|y-x\right|\right]^2dx\end{array}\right\} \tag{2.14}$$

where $\Pi^{(3)}_{merged}$ denotes the profit of the merged firm in triopoly.

The candidates to optimal locations are obtained by solving the simultaneous system formed by the FOCs in d, z and y respectively on the above profits. Checking for the second order conditions gives us the equilibrium locations. In terms of explicit computations,

twelve cases need to be discussed, depending on the relative positions of the two single-store competitors w.r.t. the two affiliates. Appendix A presents all the technical details, but we list next the twelve cases as well as the corresponding conditions defining them and the ultimate outcome of the maximization problem for each case respectively:

case 1	$0 \leqslant z \leqslant y \leqslant d \leq 1/2 \leq z + 1/2 \leq y + 1/2 \leq 1 - d \leq 1$	no solution
case 2	$0 \leq z \leq y \leq d \leq 1/2 \leq 1 - d \leq z + 1/2 \leqslant y + 1/2 \leqslant 1$	no solution
case 3	$0 \leq d \leqslant z \leqslant y \leqslant 1/2 \leq 1 - d \leq z + 1/2 \leq y + 1/2 \leq 1$	no solution
case 4	$0 \leq z \leq y \leq d \leq 1/2 \leq z + 1/2 \leq 1 - d \leq y + 1/2 \leq 1$	no solution
case 5	$0 \leq z \leq d \leq y \leq 1/2 \leq 1 - d \leq z + 1/2 \leq y + 1/2 \leq 1$	no rational solution
case 6	$0 \leq z \leq d \leq y \leq 1/2 \leq z + 1/2 \leq 1 - d \leq y + 1/2 \leq 1$	$z = 0, y = 1/2, d = 1/4$
case 7	$0 \leq z \leq d \leq y - 1/2 \leq 1/2 \leq z + 1/2 \leq 1 - d \leq y \leq 1$	$z = 1/4, y = 3/4, d = 1/4$
case 8	$0 \leq y - 1/2 \leq d \leq z \leq 1/2 \leq y \leq 1 - d \leq z + 1/2 \leq 1$	$z = 1/4, y = 3/4, d = 1/4$
case 9	$0 \leq z \leq y - 1/2 \leq d \leq 1/2 \leq 1 - d \leq z + 1/2 \leq y \leq 1$	$z = 1/4, y = 3/4, d = 1/4$
case 10	$0 \leq z \leq y - 1/2 \leq d \leq 1/2 \leq z + 1/2 \leq y \leq 1 - d \leq 1$	$z = 0, y = 1/2, d = 1/4$
case 11	$0 \leq y - 1/2 \leq z \leq d \leq 1/2 \leq y \leq 1 - d \leq z + 1/2 \leq 1$	no rational solution
case 12	$0 \leq z \leq y - 1/2 \leq d \leq 1/2 \leq z + 1/2 \leq 1 - d \leq y \leq 1$	no solution

The bottom line is that both the two affiliates and the two outsiders locate diametrically. Basically, either the two affiliates locate at 1/4 and 3/4 and the two outsiders locate either at 0 and 1/2 respectively, or the latter share each the location of an affiliate, namely 1/4 and 3/4. Therefore the post-merger equilibria look as follows:

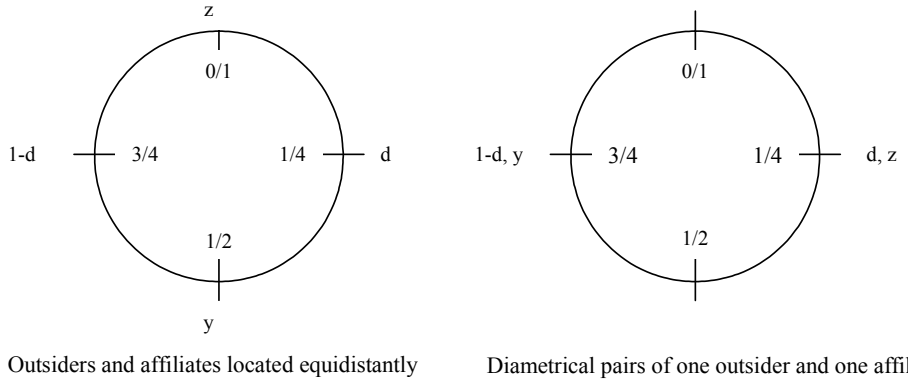


Figure 2.4: Location equilibria after merger to triopoly

Profitability analysis

Once the post-merger spatial patterns have been pinned down, the profitability analysis is actually straightforward, because the two post-merger equilibria are thoroughly equivalent in terms of profits.

When the outsiders and the affiliates locate equidistantly (cases 6 and 10 above), the profit of the merged entity writes:

$$\Pi^{(3)}_{merged} = \frac{1}{16}\left\{\begin{array}{l} \int_0^{1/4}\left[a+x+(1/2-x)-3(1/4-x)\right]^2 dx+ \\ \int_{1/4}^{1/2}\left[a+x+(1/2-x)-3(x-1/4)\right]^2 dx+ \\ \int_{1/2}^{3/4}\left[a+(1-x)+(x-1/2)-3(3/4-x)\right]^2 dx+ \\ \int_{3/4}^{1}\left[a+(1-x)+(x-1/2)-3(x-3/4)\right]^2 dx \end{array}\right\} = \frac{\frac{1}{4}a+a^2+\frac{1}{16}}{16} \tag{2.15}$$

whereas is the outsiders share the diametrical locations of the affiliates (cases 7,8 and 9), the profit of the merged entity writes:

$$\Pi^{(3)}_{merged} = \frac{1}{16}\left\{\begin{array}{l} \int_0^{1/4}\left[a+(1/4-x)+(1/4+x)-3(1/4-x)\right]^2 dx+ \\ \int_{1/4}^{1/2}\left[a+(x-1/4)+(3/4-x)-3(x-1/4)\right]^2 dx+ \\ \int_{1/2}^{3/4}\left[a+(x-1/4)+(3/4-x)-3(3/4-x)\right]^2 dx+ \\ \int_{3/4}^{1}\left[a+(1-x+1/4)+(x-3/4)-3(x-3/4)\right]^2 dx \end{array}\right\} = \frac{\frac{1}{4}a+a^2+\frac{1}{16}}{16} \tag{2.16}$$

Given the thorough profit equivalence of the location equilibria *both* before and after the merger to triopoly, the profit comparison necessary for the profitability assessment is quite simple:

$\Pi^{(3)}_{merged} - \sum \Pi_{before} = \frac{\frac{1}{4}a+a^2+\frac{1}{16}}{16} - 2\left(\frac{\frac{7}{12}-\frac{1}{2}a+a^2}{25}\right) = \frac{89}{1600}a - \frac{7}{400}a^2 - \frac{821}{19\,200} < 0,\ \forall a \geq 2$

where the latter condition ensures that all firms supply positive quantities throughout the set of local markets.

The conclusion is unambiguous: the merger to triopoly is not profitable. Note that this time there is no captive demand available at all, since in both post-merger equilibrium patterns, each affiliate faces an outsider on each side. Basically, despite relocation, the merged entity cannot isolate itself from outsiders' competition. As a consequence, the

spatial efficiency gains obtained through relocation cannot be put to profitable use due to the lack of captive demand to supply at lower cost.

Another way to justify the lack of profitability for mergers to triopoly is to notice that the post-merger equidistant spatial pattern perfectly replicates the equidistant pre-merger spatial equilibrium, provided that diametrically opposite outlets merge. In other words, and given the proven profit equivalence between the spatial patterns, the merger to triopoly does not actually trigger relocation for the merged entity. But, without effective relocation, mere output reallocation cannot ensure merger profitability (Norman and Pepall (1998, 2000)), therefore the merger to triopoly cannot be profitable, q.e.d.

2.3 Conclusion

We show here by two examples that on the circular market, horizontal Cournot mergers with endogenous location become unprofitable much earlier than on the segment. On the circle, a merger to *triopoly* is not profitable, whereas on the segment the profitability result was valid up to *initially eight firms*. This suggests that the circular market is much more subject to the merger paradox than the segment, and that for more than four firms in the market mergers are not profitable. This conjecture still wants formal proof for the time being, but the technical complexity of the general case is by now acknowledged to be prohibitive. Nevertheless, we venture to remark that since horizontal merger profitability generally increases with market concentration, it is highly unlikely that mergers turn out to be profitable for more than four firms on the market.

In terms of economic insights that this chapter proposes, we basically stress the intuition that the incentives to merge are higher when there is some form of market asymmetry that firms may benefit from, which consistent with a corollary of Deneckere and Davidson (1985), according to which in markets with symmetric intensity of competition the incentives to profitably merge are considerably lower.

Second of all, this paper contributes to the question of location choices of multi-store firms. On the linear market, location equilibria for multi-store firms have already been completely worked out - Pal and Sarkar (2002) exhaustively analyze competition between

multi-store firms on the segment and prove that the complex problem of determining equilibrium store locations can be approximated by a lot simpler one. Note that this is also entirely possible thanks to the existence of endpoints. On the circle, where all locations are *a priori* homogeneous, Chamorro-Rivas (2000) chooses a certain perfectly symmetric framework, i.e. a two-plant duopoly, to obtain the 'equidistance result'. However, more results are necessary on spatial competition between multi-store firms, since on the circle, this analysis is yet incomplete. So far, completely asymmetric firms in their number of affiliates (more than one) have not been considered. We contribute by working out two particular cases, the location equilibria between a two-plant firm and one or two single-plant competitors[23]. The 'equidistance result' can be obtained only in the latter case, and multiple equilibria[24] obtain in both cases. We argue that the number of plants of the merged firm, as well as the number of single-store competitors are important parameters, in presence of the circularity assumption. From a more general viewpoint, this suggest that despite the multi-plant assumption, multiplicity still characterizes location equilibria on the circular market, as compared to the linear one.

[23] To our knowledge, this is the first attempt to date dealing with an asymmetric number of stores across firms.

[24] Given the multiple equilibria we obtain for both pre- and post-merger situations, both in the duopoly and triopoly cases, it has been suggested that such (re)location costs might be useful to select a unique spatial pattern. But on the one hand, checking the property of multiple equilibria of the circular city in the case of multi-plant competition is a secondary purpose of this chapter. On the other hand, equilibrium selection would not apply for the merger to triopoly case, because even without such (re)location costs, it is shown to be unprofitable, regardless of the precise spatial pattern obtaining. Finally, a discussion of the assumptions allowing to select a unique spatial equilibrium would be needed, because the multiplicity problem is basically due to both the location homogeneity on the circular market, but as well to the transport cost linearity. Convex or concave transport costs w.r.t. distance would most likely prevent multiple spatial equilibria. Matsumura et al. (2005) examine the impact of transport cost non-linearity, and find that only the quidistant pattern (for single-plant competition on the circle) is robust to it.

Chapter 3

Merger, spin-off and divestiture: Profitability insights from a spatial model

"First they buy, and then they sell... many companies now resemble equity firms in their strategies...buying and selling enterprises are the whole point, not selling products or services".

(Oligopoly Watch, November 13, 2005)

This chapter is based on Cosnita (2006) "Merger, spin-off and divestiture: insights from a spatial model." Economics Bulletin, Vol. 4, No. 9 p. 1-9

3.1 Introduction

A most puzzling and debated issue concerns the performance of mergers and acquisitions (M&As). If the theory warns that the merger may lower profits (see Chapter 2), a substantial bulk of empirical studies (either "event studies"[1] or belonging to the "empirical IO literature"[2]) agree in their turn that the emerging picture is pessimistic for merger profitability. For instance, Gügler et al. (2003) use a large panel data set in order to analyze the effects of mergers internationally and over time. By comparing merging firms' profits and sales before and after the merge, they find that many mergers decrease profits and efficiency, (although there do exist mergers that increase profits), and these results are similar across different countries and sectors, as well as between domestic and cross-border mergers. Earlier "outcome studies", which investigate the firms' economic performance and balance sheets before and after the acquisition, equally found that far from creating value, M&As are often unprofitable for participants, a "disappointing marriage" to put it short (see Meeks (1977)). Even summarizing about 80 empirical studies, the same disappointing aftertaste is obtained by Tichy (2001).

It is difficult to skim through all this evidence without concluding that many firms are too optimistic about mergers, and/or that hubris is a major cause of mergers. Indeed, the academic interest for merger performance advanced explanations which rely on the assumption that shareholders lack the instruments to discipline their managers, who overestimate their abilities (Roll (1986)), or that the managers pursue other motives than value maximization, such as the size of their organization (Shleifer and Vishny (1988)). Such hubris or empire-building explanations suggest the failure of the disciplining power of the capital market on the internal efficiency of firms, since the latter can acquire assets which they do not run efficiently.

An alternative[3] (less troublesome?) explanation depicts profit flows reductions as a

[1] They investigate how the stock market values the merger when the latter is publicly announced, by comparing share prices a few weeks before and after the announcement/event - see Banerjee and Eckard (1998) for instance.

[2] The M&A performance is tested by comparing profit flows a few years before and after the transaction - see Ravenscraft and Scherer (1987) for instance.

[3] By no means unique - Banal-Estanol and Seldeslachts (2006) propose an explanation as to why some

consequence of competitive forces at on the product market - Fridolfsson and Stennek (2005,b) point out a defensive motivation for mergers. In their pre-emptive merger mechanism, an unprofitable merger may occur if mergers generate strong negative externalities on external firms, so that being an outsider is even more unprofitable than taking part in a merger. As a result, firms may merge even if this lowers their profit, in order to pre-empt their partner from merging with someone else, which would confine them to the least-profitable outsider position. In contrast to the exogenous merger literature, which implies that *per se* profitability is the relevant criterion for the study of mergers, the mechanism of Fridolfsson and Stennek (2005,b) relies on the fact that the relevant alternative for the merger assessment is not the status-quo, but another merger.

The spatial setting provides further insight (and supplementary robustness) for such a pre-emptive mechanism. Space differentiates outsiders inasmuch as they suffer more or less from a given merger, depending on their distance w.r.t. the merger partners. The model devised by Brito (2003) exploits this outsider heterogeneity in terms of incentives to pre-empt the merger. By endogenizing the decision to merge in Levy and Reitzes's (1992) price competition circular model, he obtains that the incentive to merge is highest for the most distant outsider (the one who benefit the least from a merger between neighbouring firms, due to the asymmetric product differentiation). As a result, firms prefer to merge rather than free-ride on others' mergers. Brito (2003) reminds that such a behaviour appears consistent with the occasional real-life attitude of outsider firms facing a merger announcement, namely to try and prevent it by proposing to acquire one of the insiders[4]. Note however that due to the localized competition in Brito's (2003) model (as in Levy and Reitzes (1992)), the closest outsiders gain more than the insiders from the merger.

mergers fail based on the interaction between the pre-merger gathering of information and the post-merger integration processes. They show that a firm may optimally agree to merge and abstain from exerting any integration effort, relying on the partner to the necessary efforts. If both partners do this, the merger goes ahead but fails.

[4]The article quotes the case of the planned friendly merger between Paribas and Societe Generale. Following the public annoucement in February 1999, Banque Nationale de Paris (BNP), France's largest bank, decided to try and acquire both banks. Since cost synergies were not presented as the main driver of the merger, market power and market interaction must have been at the origin of this reaction, which was moreover interpreted as due to the fear of being left outside the merger.

Therefore, even if a pre-emptive merger ensures a higher profit w.r.t. the situation of a most distant outsider, and moreover, despite merger internal profitability, to merge is not the most profitable strategy - being (spatially) next to the merged firms is.

3.1.1 Purpose and relevance

Sticking with the spatial framework, this chapter deals with acquisition and de-acquisition and builds on the two ideas mentioned so far. By means of a simple model, we show that post-merger de-acquisition (in the sense of divisionalization) can improve pre-merger profits more than the merger alone can. On the one hand, this holds when the merger itself is not profitable, which suggests a motivation for apparently unprofitable mergers (just a step in a complex corporate move to raise profitability). On the other hand, this holds also when the merger is profitable in the first place, so in a way we discuss the 'optimality' of merger (in the sense of best alternative) in relation with its internal (un)profitability[5]. With this respect, we show that the merger can be 'optimal', whatever its profitability, provided it is part of a global corporate strategy including subsequent divisionalization. If anything, this chapter argues that the analysis of merger performance in isolation may be incomplete, since firms engage in complex growth strategies involving a wider range of restructuring, beyond mergers.

The contribution of this chapter is to examine in a spatial setting the relationship between merger (in the sense of consolidation, joint operation) and de-acquisition (in the sense of divisionalization, spin-off). They are, by definition, opposite business strategies, but firms use them both to enhance value.

Weston (2001) recalls that in response to economic, political, and technological developments, firms resort to many adjustment processes, and it is myopic to view mergers and takeovers as the only, or main, adjustment process[6]. For business strategists it is particularly relevant to identify the potential for adding value through acquisitions *and*

[5] In the Fridolfsson and Stennek (2005,b) model, the merger is optimal although not internally profitable, because it is even less profitable to become an outsider. In the Brito (2003) model, the merger is not optimal although internally profitable.

[6] Restructuring and reorganization strategies include divestitures, equity carve-outs, spin-offs, split-ups, which are all value based management processes, meant to lower costs and improve revenue growth.

de-acquisitions, especially considering the evidence that complex and acquisition-intensive firms often fail to add value, and are even reckoned to be more 'valuable' if broken-up into their constituent parts[7]. In view of this, Maksimovic and Phillips (2001) not surprisingly found, based on a sample of plant-level data from 1974 to 1992, that the market for individual plants and divisions is extensive, with an annual average rate of reallocation of 3.89%. Moreover, the combined effects of acquisitions and divestitures comfort the wealth-creation hypothesis, as illustrates the empirical study by Mulherin and Boone (2000) of a sample of 1305 firms from 59 industries, spanning over the 1990-1999 period. Their data equally show significant time clustering in both acquisitions and divestitures, which is consistent with the observation that mergers come in waves, followed by intensive industry restructuring by means of voluntary asset sales and spin-offs.

The point we wish to make in this chapter is precisely that the sequence of merger and divisionalization is a profit-enhancing strategy for firms. From the theoretical point of view, they are not only opposite strategies, but also mutually exclusive for Cournot competitors from the profitability viewpoint, at least as long as the linearity assumptions on demand and cost functions are maintained. With constant identical marginal costs and product homogeneity, Cournot merging partners acting jointly necessarily contract output and thus provide a double positive externality for outsiders, which benefit from both the price and their output raise. The insiders' output contraction and the ultimately lower than planned price increase may well lower the profit of the merged firms below what they earned pre-merger. Salant et al. (1983) show that with linear demand and identical constant costs, the merger is internally unprofitable, unless at least 80% of the industry firms take part in it. This result basically mirrors the bargaining paradox revealed by Harsany (1977): among n players bargaining over the division of a pie, if two players form a coalition and act as one, they only get $\frac{1}{n-1}$, whereas acting independently each would

[7] For instance, Stadler, Campbell and Koch (1997) calculate that there was (at the time) one trillion dollars worth of shareholder value locked up waiting to be released by the breakup of multi-business corporations in the United States and the UK. They quoted prominent giants, keen on serial acquisitions, as General Motors or Ford, as being in need of breaking up. They claimed that breaking up these firms into far more focused businesses will create enormous improvements in company performance and, along with it, vastly increased shareholder wealth.

obtain $\frac{1}{n}$. This suggests that on the contrary, firms have opposite incentives to split up into independent units and thus capture more of the pie.

3.1.2 Related literature

This intuition is exploited by the literature on divisionalization in a Cournot industry, which established that firms have unilateral incentives to form independent competing units under certain conditions. Basically, by creating a new division the overall industry profit diminishes due to increased competition, but the market share of the firm is higher, as well as its share in the total profit. Polasky (1992) shows, under the same linearity assumptions as Salant et al. (1983), the profitability of divisionalization for a set of firms that would find merger unprofitable. This is so because dividing into multiple independent firms allows to not coordinate the output decisions within the entire group in the subsequent quantity stage. In other words, and contrary to the case of merger, divisionalization represents a credible commitment to increase total output. From this viewpoint, spin-off and adopting the Stackelberg behaviour are equivalent[8]. Polasky (1992) notes however that it may prove more costly to operate as independent divisions rather than a single unified firm because of economies of scale, or the difficulty of splitting assets. The subsequent contributions on the topic allowed rival firms to resort to divisionalization. With linear demand, constant returns to scale and homogenous commodity, Corchon (1991)[9] and Baye et al. (1996) both agree that Cournot divisionalization tends to increase social welfare and reduce firm profits, basically converging to perfect competition[10]. Gonzalez-Maestre (2001) extends this result to the case of heterogenous goods and price competition, in a spatial differentiation model *à la* Salop (1979). This incidentally highlights the robustness of the incentive to divisionalize as a "top dog" strategy (i.e. commitment to an aggressive

[8] More precisely, Polsaky (1992) shows that the two-stage divisionalization-quantity game and the Stackelberg game with one leader and n followers yield the same equilibrium outcome under the linear demand and constant identical cost assumptions.

[9] Later generalized by Corchon and Gonzalez-Maestre (2000) to other forms of demand functions.

[10] This is obtained by the former by assuming costless divisionalization but an upper limit on the permissible number of divisions per firms, and by the latter by assuming a fixed cost per division.

behaviour)[11].

In this chapter, we also make use of the spatial setting, but to address the opposition between merger and divisionalization. By means of a very simple spatial Cournot model, we question the optimality of complete integration of affiliates through merger, despite the profitability of this strategy[12]. We find that the highest post-merger profit is actually obtained by only partially integrating affiliates. This partial divisionalization behaviour is consistent with general business practices in franchising, with franchisees usually not being allowed to sell franchises themselves. Our framework basically corresponds to the organizational setup where the parent firm functions as a holding company, allowing its subsidiaries to manage independently, but retaining the authority to establish subdivisions.

In a non-spatial model with heterogenous constant marginal costs, Tombak (2002) discusses the decision to consolidate or not following a take-over. Merger profitability is restored if affiliates are run separately as independent divisions. This is made possible in his framework by cost differentials, which ultimately enable profitable technology transfers between affiliates. The paper also studies the link between integration and opportunity to monopolize a market[13], and concludes that consolidation of affiliates is optimal only for a merger to monopoly, or, in the limit case, for a firm prevented from further acquisitions by the anti-trust agency.

Our very simple framework conforms with this conclusion, in as much as the merged entity fares better by running independent divisions. However, we contradict the optimality of total divisionalization (i.e. single-store divisions), because by running independent

[11] However, it may equally correspond to a "fat cat" attitude, as shown by Tan and Yuan (2003). This paper models price-competing conglomerates with complementary product lines and products across the groups being imperfect substitutes. Such rivals have incentives to spin-off their complementary product lines, because by doing so a firm commits to not coordinate the pricing of its divisions, which will soften the second-stage price competition. The symmetrical incentives to divest eventually increase all product prices, as well as parent firms' profits, but also lower total welfare.

[12] We remind that by creating delivery cost differentials, the spatial framework allows merging firms to profitably coordinate output decisions, provided though they relocate (see McAffe et al. (1992) and Norman and Pepall (1998, 2000)). Chapter 2 details the resolution of merger profitability paradox in the spatial setting.

[13] See also Kamien and Zang (1990,1993)

multi-store divisions, the merged firms makes the most of the respective advantages of both merger and divisionalization. In a spatial Cournot setting, the ownership of several plants by the merged entity prompts relocation, and thereby locational efficiency gains. These ensure merger profitability, because the merged entity serves distant demand at a strictly lower delivery cost than its rival. Nevertheless, the benefit extracted from the optimal relocation of its several plants is actually enhanced if the group spins off instead into multi-plant divisions. This preserves its net cost advantage over the distant demand, but equally allows it to credibly maintain a high output at *every* local market. To sum up, our model illustrates the possible complementarity in a spatial setting between merger and subsequent divisionalization within a two-step profit-enhancing business strategy[14].

On the other hand, given that divisionalization or spin-off basically comes down to an asset transfer between firms, our framework lends itself to an interesting and alternative interpretation in terms of mandatory divestitures required by a competition authority. The outcome of the example we device in this chapter is identical to that following the divestiture of a multi-plant division to a new entrant. Therefore our profitability analysis of the merger-divisionalization strategy allows us to discuss the impact of divestitures for merger profitability. And since the spin-off we consider is profitable even when the initial merger is not, the same holds for the equivalent mandatory divestiture. This may be interpreted as a rationale for unprofitable mergers, which may be submitted so as to entail profitable divestitures afterwards. We equally provide the price comparison justifying the application of such a structural remedy to the merged firms, as well as the ultimate market price outcome of the divestiture. We find that although it improves merger performance, the divestiture is nevertheless effective, to the extent that it fulfills its corrective role to lower the post-merger price.

The remainder of the chapter is organized as follows. The next section presents the model. Then the post-merger market equilibrium is established, and the profitability of

[14] As compared with Tombak (2002), where the incentive to hold separate after merger was motivated in the cost asymmetry and subsequent cost-minimizing technological transfer between affiliates, here we suggest that decentralization is opportune at the division level, provided that relocation decisions are optimally taken within divisions, so as to obtain locational efficiency gains.

merger (in the sense of consolidation) is discussed. Partial divisionalization (in the sense of multi-plant spin-off) is considered next, and again we establish first the corresponding market equilibrium so as to discuss its profitability consequences. We interpret the outcome in terms of impact of mandatory divestiture on merger profitability, and conclude by examining the price consequences of the divestiture.

3.2 Model

The framework we consider is the simplest possible, given our objective to account for both merger and multi-plant divisionalization in a consistent manner. So as to avoid merger to monopoly, we consider a triopoly market. And since we intend to discuss partial, i.e. multi-plant divisionalization for the resulting merged group, the lowest number of divisions allowing to do so is two, and the minimum number of plants/stores per division is also two. As a result, the post-merger situation will consist of one outsider and four insider plants. At the same time, to perform a consistent comparison between the pre- and post-merger patterns, the former should not exhibit two two-store symmetric merging firms, and the only other ownership distribution between the future four affiliate plants is to have a three-plant insider on the one hand, and one single-plant insider on the other. To sum up, the framework we retain is the simplest possible that can consistently capture the various situations we wish to study, and consists of a bilateral merger between the three-store firms and one of its single-store rivals[15].

With respect to the spatial setting, we build our merger analysis on the linear shipping model of Norman and Pepall (2000) and Pal and Sarkar (2002) - the only change concern basically the particular number of firms and plants we retain. Using the same notations introduced in the second chapter, let the spatial triopoly above-mentioned Cournot triopoly serve a linear market of unit length. Without loss of generality, the interval $[0, 1]$ represents the linear market. An infinite number of consumers are distributed uniformly over this unit segment. At any consumer location x on the segment, $x \in [0; 1]$, demand

[15] This particular bilateral merger also lends itself well to our final divestiture interpretation, simply because discussing divestitures cannot possibly be relevant when two single-store firms merge (divesting one of the two plants implies that the merger should not have occured in the first place).

is given by $p(x) = a - Q(x)$, $a > 0$, where $p(x)$ is the product price at that location and $Q(x)$ is the total output supplied at x. Here x is the distance measured from the left endpoint of the market. The three Cournot firms equally locate their stores in $[0, 1]$. They produce a homogeneous good with the same technology exhibiting constant marginal costs, normalized to zero. The firms also have identical transport technologies, and pay a transport cost $(t\,|x - x_i|)$, linear in distance and quantity, in order to ship output to consumers located at x from a plant located at x_i, where $i = 1, 2, 3, 4, 5$. For ease of exposition, let stores 1, 2 and 3 be jointly owned, whereas plants 4 and 5 be individually run. t is a positive constant, but since the transport cost parameter enters as a multiple in the profits expression, for our profitability analysis let $t = 1$ without loss of generality, or, equivalently, let a be the transport-cost adjusted reservation price. Arbitrage among the consumers is assumed to be infeasible due to high transaction costs (equivalently, consumers are assumed to have a prohibitive costly transport cost, preventing arbitrage), so by delivering the product firms can and will price discriminate among consumers across the set of spatially differentiated markets. There are no set-up or (re)location costs, nor merging or spinning-off costs. Let $a > 1.5$, so that each firm supplies a positive quantity at every local market[16]. We consider a simple two-period post-merger game: firms relocate simultaneously and then simultaneously play Cournot. The equilibrium concept is the subgame perfect Nash equilibrium.

The discussion is organized as follows: based on the post-merger equilibrium with centralized decision-making, we check corresponding merger profitability[17]. Then we show that partial spin-off (involving equilibrium relocation) increases the merged entity's profit, and interpret this in terms of a divestiture-based outcome.

[16] The general condition ensuring on the segment that all firms cover in equilibrium the whole market is $a > \frac{n \cdot t}{2}$ (see Norman and Pepall (2000) - basically, this is the requirement for an interior Cournot equilibrium, i.e. a sufficient high reservation price w.r.t. costs). With $n = 3$ and $t = 1$, we obtain the condition in the text.

[17] Norman and Pepall (2000) made clear that Cournot spatial mergers involving centralized decisions can only be profitable if stores relocate.

3.2.1 Merger: profitability of consolidation

To discuss merger profitability, we identify first the location equilibria before and after merger. To do so, each time the location-Cournot game needs to be solved. This is done by backward induction, and the local Cournot competition is examined first. Since marginal production cost is constant and arbitrage among the consumers is not feasible, quantities set at different points by the same firm are strategically independent. Therefore, the second stage Cournot equilibrium is characterized by a set of independent Cournot equilibria, one for each market point x. Generally denoting by x_j a firm's location, $x_j \in [0,1]$, and by $q_j(x)$ its output at a given location x, we remind that under the above assumptions, at each point $x \in [0,1]$ firm j makes profit given by

$$\pi_j(q_j(x), q_{-j}(x); x) = \left[a - t\left|x_j - x\right| - q_j(x) - \sum_{k \neq j}^{2} q_k(x) \right] q_j(x) \tag{3.1}$$

Taking first order conditions to solve for the unique Cournot equilibrium yields

$$q_j^*(x) = \frac{1}{4}\left[a + \sum_{k \neq j}^{2} t\left|x_k - x\right| - 3t\left|x_j - x\right| \right] \tag{3.2}$$

Taking into account that aggregate supply at x writes $Q^*(x) = \frac{1}{4}\left[3a - \sum_1^3 t\left|x_k - x\right|\right]$, the individual profit function at x can be rewritten as

$$\pi_j^*(x) = \left[q_j^*(x)\right]^2 \tag{3.3}$$

which is standard Cournot outcome given the assumptions made. Finally, firm's j total (i.e. over the whole set of spatial markets) profit function is

$$\Pi_j(x_j, x_{\neq j}) = \int_0^1 \pi_j^*(x_j, x_{\neq j}; x)dx \tag{3.4}$$

At the first stage, each firm maximizes its own total profit function in own location. The outcome of this simultaneous subgame in locations represents the pre-merger spatial equilibrium.

Pre-merger market equilibrium

In order to determine it, we rely heavily on the general location results for multi-plant Cournot competition on the linear market obtained by Pal and Sarkar (2002), instead of

laboriously solving out for the simultaneous location equilibrium involving three firms and five outlets. Directly applying the analysis of Pal and Sarkar (2002) to our case, meaning triopoly with two single-store firms and one three-store firm, yields that both single-store firms locate at the market center, together with one of the 3-store firm's outlets, whereas its remaining two stores are symmetrically located around the segment midpoint, on account of both the symmetry w.r.t. the latter and the quantity-median property. To complete the identification of the pre-merger spatial equilibrium, we need only determine the equilibrium locations of the two stores that the three-outlet firms locates each within a distinct half-market.

Denote 1 and 2 these two outlets, whose locations are denoted x_1 and x_2 respectively. Basically, the pre-merger spatial pattern looks as follows:

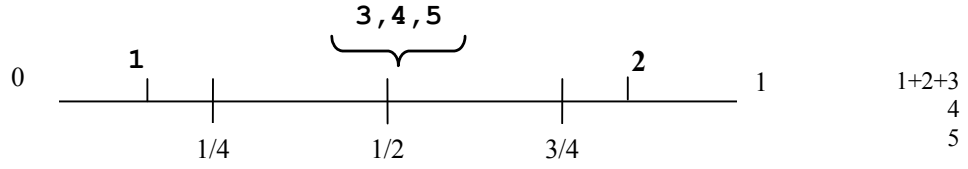


Figure 3.1: Pre-merger spatial equilibrium

The locations of the two 'exterior' stores satisfy $x_2 = 1-x_1$ due to the spatial symmetry, and will be determined as the solutions of the location-maximization problem on the 3-store firm's profit[18], which is by the same token defined symmetrically w.r.t. the segment middle. Therefore it writes

$$\begin{aligned}\Pi_{1,2,3} &= 2\left(\begin{array}{c}\int_0^{x_1}\left(\frac{a-3(x_1-x)+2(1/2-x)}{4}\right)^2 dx + \int_{x_1}^{\frac{x_1+1/2}{2}}\left(\frac{a-3(x-x_1)+2(1/2-x)}{4}\right)^2 dx \\ + \int_{\frac{x_1+1/2}{2}}^{1/2}\left(\frac{a-3(1/2-x)+2(1/2-x)}{4}\right)^2\end{array}\right) \quad (3.5)\\ &= \frac{1}{64}a + \frac{9}{128}x_1 + \frac{3}{16}ax_1 + \frac{1}{16}a^2 - \frac{33}{64}x_1^2 + \frac{23}{32}x_1^3 - \frac{9}{16}ax_1^2 + \frac{7}{768}\end{aligned}$$

Due to symmetry, only one First Order Condition (FOC) is needed:

$$\frac{\partial}{\partial x_1}\Pi_{1,2,3} = 0 \Leftrightarrow \frac{3}{16}a - \frac{33}{32}x_1 - \frac{9}{8}ax_1 + \frac{69}{32}x_1^2 + \frac{9}{128} = 0$$

[18] Remember that each firm serves a market point by incurring the lowest possible transport cost, hence from the store which is nearest to the market point. Consequently, two stores of the same firm never coincide, and each store serves a contiguous market around itself. Also, on each side, a store's market extends up to the midpoint between itself and the next store owned by the same firm.

Checking against the Second Order Condition (SOC) on the above profit expression:

$$\frac{\partial^2}{\partial x_1^2}\Pi_{1,2,3} \leq 0 \Leftrightarrow \frac{3}{32}\left(46d - 12a - 11\right) \leq 0$$

the optimal location x_1^* is

$$x_1^* = \frac{6}{23}a - \frac{1}{23}\sqrt{20a + 36a^2 + 13} + \frac{11}{46} \tag{3.6}$$

In order to be able to compute the initial global profit of the future merger partners, we need first the expression of the single-store firm participating to the merger. Index by 4 this firm, whose profit writes (due to symmetry)

$$\begin{aligned}\Pi_4 &= 2\left(\begin{array}{c}\int_0^{x_1}\left(\frac{a-3(1/2-x)+(x_1-x)+(1/2-x)}{4}\right)^2 dx \\ +\int_{x_1}^{\frac{x_1+1/2}{2}}\left(\frac{a-3(1/2-x)+(x_1-x)+(1/2-x)}{4}\right)^2 dx \\ +\int_{\frac{x_1+1/2}{2}}^{1/2}\left(\frac{a-3(1/2-x)+2(1/2-x)}{4}\right)^2\end{array}\right) \\ &= \frac{5}{128}x_1 - \frac{3}{64}a - \frac{1}{16}ax_1 + \frac{1}{16}a^2 - \frac{13}{64}x_1^2 + \frac{17}{96}x_1^3 + \frac{3}{16}ax_1^2 + \frac{11}{768}\end{aligned} \tag{3.7}$$

To compute the pre-merger global profit of the merging partners it is enough to evaluate $[\Pi_{1,2,3} + \Pi_4]$ in $x_1^* = \frac{6}{23}a - \frac{1}{23}\sqrt{20a + 36a^2 + 13} + \frac{11}{46}$. See Appendix B for computation details. Finally, the profit values that will be used for the profitability comparison are obtained for different levels of the demand parameter a, and are entered into Table 3.1 below:

Table 3.1: Pre-merger profits

a	1.5	2	2.5	3	3.5	4	4.5	5	6
x_1^*	0.14628	0.15062	0.15345	0.15544	0.15691	0.15804	0.15894	0.15967	0.16078
$\Pi_{1,2,3} + \Pi_4$	0.27663	0.48481	0.75554	1.0888	1.4846	1.9429	2.4637	3.0470	4.4011

Post-merger market equilibrium

After merger, the remaining duopoly involves a single-store firm (whose outlet was denoted 5) and a four-store merged entity. The spatial Cournot competition between the two firms implies, as shown by Pal and Sarkar (2002), that the single-outlet outsider does not relocate from the segment midpoint, whereas the merged entity locates two

stores within each half-segment, symmetrically around the mid-point. The spatial pattern basically looks now as follows:

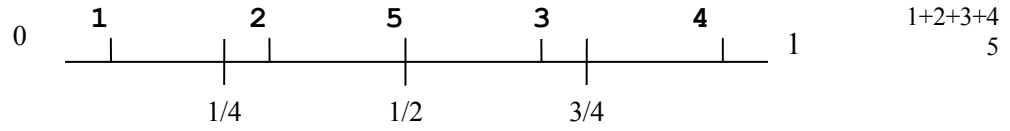


Figure 3.2: Post-merger spatial equilibrium

To determine the post-merger spatial equilibrium, we need to identify the profit-maximizing locations for the four outlets of the merged entity. To do so, as before, we must first write the merged firm's profit. Taking into account the symmetry w.r.t. the segment middle point, only the notations x_1^M and x_2^M for the left-hand side locations are necessary, and the profit expression consequently writes:

$$\Pi_{1,2,3,4}^M = 2\left(\begin{array}{c}\int_0^{x_1^M}\left(\frac{a-2(x_1^M-x)+(\frac{1}{2}-x)}{3}\right)^2dx+\int_{x_1^M}^{\frac{x_1^M+x_2^M}{2}}\left(\frac{a-2(x-x_1^M)+(\frac{1}{2}-x)}{3}\right)^2dx\\+\int_{\frac{x_1^M+x_2}{2}}^{x_2^M}\left(\frac{a-2(x_2^M-x)+(\frac{1}{2}-x)}{3}\right)^2dx+\int_{x_2^M}^{1/2}\left(\frac{a-2(x-x_2^M)+(\frac{1}{2}-x)}{3}\right)^2dx\end{array}\right)$$
$$=\frac{4}{9}a\left(x_2^M\right)-\frac{1}{9}\left(x_2^M\right)-\frac{1}{18}a+\frac{2}{9}\left(x_1^M\right)\left(x_2^M\right)+\frac{4}{9}a\left(x_1^M\right)\left(x_2^M\right)+\frac{1}{9}a^2-\frac{1}{3}\left(x_1^M\right)^2+\frac{13}{27}\left(x_1^M\right)^3$$
$$+\frac{1}{9}\left(x_2^M\right)^2+\frac{1}{27}\left(x_2^M\right)^3-\frac{2}{3}a\left(x_1^M\right)^2-\frac{2}{3}a\left(x_2^M\right)^2-\frac{1}{3}\left(x_1^M\right)\left(x_2^M\right)^2+\frac{1}{9}\left(x_2^M\right)\left(x_1^M\right)^2+\frac{1}{36}$$

To find the optimal locations $\left(x_1^M\right)^*$ and $\left(x_2^M\right)^*$ which maximize this profit, the simultaneous system of FOCs needs to be solved, then the candidates locations are checked against the SOCs. The First Order Conditions' system is the following:

$$\left\{\begin{array}{l}\frac{\partial}{\partial x_1^M}\Pi_{1,2,3,4}^M=\frac{2}{9}x_2^M-\frac{2}{3}x_1^M-\frac{4}{3}ax_1^M+\frac{4}{9}ax_2^M+\frac{2}{9}x_1^Mx_2^M+\frac{13}{9}\left(x_1^M\right)^2-\frac{1}{3}\left(x_2^M\right)^2=0 \text{ and}\\ \frac{\partial}{\partial x_2^M}\Pi_{1,2,3,4}^M=\frac{4}{9}a+\frac{2}{9}x_1^M+\frac{2}{9}x_2^M+\frac{4}{9}ax_1^M-\frac{4}{3}ax_2^M-\frac{2}{3}x_1^Mx_2^M+\frac{1}{9}\left(x_1^M\right)^2+\frac{1}{9}\left(x_2^M\right)^2-\frac{1}{9}=0\end{array}\right.$$

This system yields no explicit general solutions, but we computed solutions for particular values of the demand parameter. Appendix B presents the method employed and the corresponding computations. Table 3.2 below presents these solutions, as well as the corresponding values for the merged entity's profit, obtained by plugging the solutions obtained into the above profit expression.

Table 3.2: Post-merger profit

a	1.5	2	2.5	3	3.5	4	4.5	5	6
$(x_1^M)^*$	0.11535	0.11764	0.11905	0.1200	0.12069	0.12121	0.12162	0.121951	0.122449
$(x_2^M)^*$	0.36354	0.36663	0.36840	0.36956	0.37036	0.37096	0.37143	0.371793	0.372339
$\Pi_{1,2,3,4}^M$	0.29644	0.50474	0.76861	1.088	1.463	1.8936	2.3797	2.9213	4.17113

Merger profitability

Table 3.3 below summarizes the profit comparison between the pre- and post-merger situations, for the different values retained for the demand parameter:

Table 3.3: Merger profitability

a	$\Pi_{1,2,3} + \Pi_4$	$\Pi_{1,2,3,4}^M$	$\Pi_{1,2,3,4}^M - (\Pi_{1,2,3} + \Pi_4)$
1.5	0.27663	0.29644	>0
2	0.48481	0.50474	>0
2.5	0.75554	0.76861	>0
3	1.0888	1.088	~ 0
3.5	1.4846	1.463	<0
4	1.9429	1.8936	<0
4.5	2.4637	2.3797	<0
5	3.0470	2.9213	<0
6	4.4011	4.17113	<0

We find that the merger is profitable for low enough values of the reservation price: $1.5 < a \leq 3$. The explanation is provided by the merger location effects: the merged entity will supply each local market from the closest store only, so as to prevent market area overlapping between stores. This output reallocation is enhanced by outlet relocation: the four affiliates spread out towards the market borders so as to minimize total transport costs. Consequently, the merger entity captures demand at the distant, extreme, consumer locations, which it can serve with a lower marginal delivery cost than the outsider. For this captive demand to be sufficient to guarantee merger profitability, the demand parameter itself needs to be low enough, otherwise, the market shares gained on demand located at the market borders do not compensate for the market shares lost throughout the segment

through output contraction[19].

To put it short, there is always an upper bound for Cournot spatial merger profitability in terms of maximum reservation price. This is so because profits are always increasing in the consumer willingness to pay a. However, a higher reservation price (larger demand) makes distance less of an issue, and the locational advantage less important, therefore a merger enabling such an advantage is less and less interesting (read: profitable) as a increases[20]. As a result, we can safely state that our (un)profitability conclusions are perfectly reliable, although we have restrained the comparison symmetrically around the critical level of demand parameter.

3.2.2 Subsequent spin-off : profitability of multi-plant divisionalization

In a non-spatial context, Cournot firms have incentives to increase their profits by means of spin-offs, i.e. acting aggressively in a credible manner, by committing to produce more (Polasky (1992), Baye et al. (1996)). On the other hand, as long as the market is not monopolized, the merger profit is enhanced if the acquired stores are run independently, provided their marginal costs differ (Tombak (2002)). In a spatial context, when locations are endogenously determined, consolidating or not production among affiliates is related to the co-ordination of location decision between them. Therefore the decision to centralize decision making, and to what extent, should take into account the potential endogenous marginal cost differences available through equilibrium relocation. We argue here that the spatial framework can also provides incentives to divisionalize, incentives related to the merger's location effects.

On the linear market, centralized decision making within the merged entity implies, from the spatial point of view, outlet relocation towards the market endpoints. Strategic substitutability requires the four stores to take up distinct locations, so as to avoid market area overlapping, so they basically spread up along the segment, two of them being each

[19] At each local market, there were three competitors pre-merger, whereas post-merger only two are left, one of which is a merged entity's plant.

[20] Furthermore, an important corollary of Pal and Sarkar (2002) indicates that when demand grows large, firms' (and plants') equilibrium locations tend to their monopoly ones. Basically, with a sufficiently large demand parameter, every firm replicates its monopoly behaviour, so a merger cannot be profitable.

close to an endpoints. This spatial pattern generates efficiency gains for the merged entity, by reducing transport cost and by allowing it to capture distant demand. Consequently, centralized decision making implies on the other hand not only the 'standard' output contraction at every local market $x \in [0,1]$, but also a locational disadvantage w.r.t. some local markets, as compared with the remaining rival. Indeed, the merged entity does capture the distant demand located close to the market borders, but at the same time its optimal relocation pattern abandons the local markets around the segment middle point to the outsider. The latter, optimally keeping its central location after merger, enjoys now a net marginal delivery cost advantage w.r.t. the local markets around 1/2.

Keeping in mind our above remarks on the spatial incentives to divisionalize, we propose to look at the following scenario. Partial divisionalization, meaning spinning off into two independent divisions, each owning two outlets, might mitigate the market share loss at the mid-segment locations, while still allowing to capture demand at distant ones.

To check this conjecture, we examine next the profitability of multi-store divisionalization and compare with the merger/consolidation performance. We also compare it with that of complete (single-store) divisionalization, so as to better seize the relative consequences of the three possible corporate strategies following merger: consolidation, complete divisionalization, partial divisionalization[21].

[21] A most recent example (August 2006) of large-scale spin-off into multi-outlet divisions is provided by the Cendant travel group. Founded in 1996, Cendant grew rapidly through scores of acquisitions, and now splits up. Cendant goes from being a semi-conglomerate holding a number of travel and tourism related brands to being four sharply focused companies. In short, it has spun off its real estate brands (Century 21, Coldwell Banker Era, and Sotheby's International Realty) as a new firm called Realogy, it has spun off its hotel/motel brands (Wyndham, Ramada, Howard Johnson, Travelodge, Days Inn and Super8) as a new firm called the Wyndham Group, and it will sell off its Travelport travel booking unit to an affiliate of equity firm Blackstone Group (brands include Orbitz, Galileo, CheapTickets, GTA). By the end of August 2006, the company will have become a new firm, named Avis Budget, after its two rent-a-car (multi-outlet) franchises, which were the latest on the group's list of acquisitions (Cendant bought Avis in 2001, and Budget Rent-A-Car in 2002).

Source: Oligopoly Watch, August 7, 2006.

Partial divisionalization equilibrium

Consider thus the merged entity spinning off into two independent two-store divisions competing against the single-store outsider. More precisely, output and location decisions are independent between divisions, but are centralized within them. Let the first division comprise stores denoted 1 and 2, and similarly stores 3 and 4 belong to the second division. Then $\Pi_{1,2}$ and $\Pi_{3,4}$ denote the divisions' profits respectively.

As before, to examine the profitability of this strategy, the location equilibrium pattern needs to be determined first. From the analysis of Pal and Sarkar (2002), applied to the particular case of a triopoly with two two-store firms and one single-store firm, we know that each division will locate both outlets symmetrically around 1/2, with rival stores sharing symmetric locations, whereas the outsider will keep its central location. The resulting spatial pattern looks as follows:

Figure 3.3: Partial (multi-store) divisionalization

To determine the equilibrium locations shared by stores 1 and 3, and 2 and 4, let rival stores 1 and 3 locate at $z \in (0, 1/2)$, whereas 2 and 4 at $1 - z$, through symmetry. The optimal location z^* maximizes a division's profit, which writes:

$$\begin{aligned} \Pi_{1,2} &= 2\left(\begin{array}{c} \int_0^z \left(\frac{a-2(z-x)+(\frac{1}{2}-x)}{4}\right)^2 dx \\ + \int_z^{\frac{1}{2}} \left(\frac{a-2(x-z)+(\frac{1}{2}-x)}{4}\right)^2 dx \end{array} \right) \\ &= \frac{1}{4}az - \frac{1}{16}z - \frac{1}{32}a + \frac{1}{16}a^2 + \frac{1}{6}z^3 - \frac{1}{2}az^2 + \frac{1}{64} \end{aligned} \tag{3.8}$$

because at each local market there is a triopoly competition, between the single-store outsider, an outlet of the $1, 2$ division and an outlet of the $3, 4$ division. The FOC on the above expression requires

$$\frac{\partial \Pi_{1,2}}{\partial z} = 0 \Leftrightarrow \frac{1}{4}a - az + \frac{1}{2}z^2 - \frac{1}{16} = 0$$

and checking against the SOC leads to

$$z^* = a - \frac{1}{4}\sqrt{16a^2 - 8a + 2} \tag{3.9}$$

To conclude on the profitability of partial integration with respect to that of total integration, we need to compute the difference between the profit of the group of two independent 2-store divisions with that of the merged entity with centralized decision making. Taking into account the expression of the optimal location z^*, the profit of the group is

$\Pi_{1,2} + \Pi_{3,4} = 2\Pi_{1,2} =$

$= \frac{5}{8}a^2 - \frac{3}{16}a - \frac{2}{3}a^3 + \frac{1}{48}\sqrt{2}\sqrt{8a^2 - 4a + 1} - \frac{1}{12}a\sqrt{2}\sqrt{8a^2 - 4a + 1} + \frac{1}{6}a^2\sqrt{2}\sqrt{8a^2 - 4a + 1} + \frac{1}{32}$.

Since in the previous section we already computed the profit of the integrated 4-store merged firm for different values of the demand parameter, to compare merger and partial divisionalization profitability we only need now to evaluate the 2-division group profit for the same parameter values. The resulting profit levels are summarized in Table 3.4 below:

Table 3.4: Partial divisionalization profit

a	1.5	2	2.5	3	3.5	4	4.5	5	6
$\Pi_{1,2} + \Pi_{3,4}$	0.28718	0.50576	0.78689	1.1306	1.5368	2.0055	2.5367	3.1304	4.5054

Before commenting on the profitability of partial divisionalization, we consider next the case of complete spin-off.

Complete divisionalization equilibrium

By complete divisionalization we mean the scenario where the merged entity runs independently its four stores. From the production decision point of view, this means that at each local market competition occurs between five firms. From the location decision viewpoint, this requires to determine the equilibrium in locations between five single-outlet firms. The resulting spatial pattern was computed by Anderson and Neven (1991) to be central agglomeration by all firms on the segment, as in the following diagram:

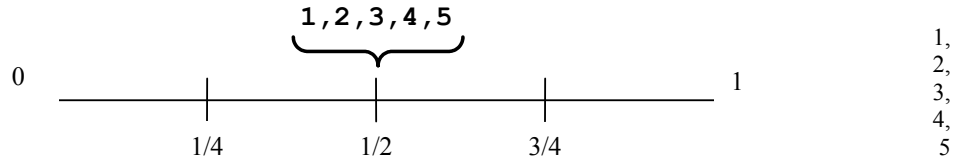


Figure 3.4: Complete (single-store) divisionalization

Let Π_{ind} be the profit of a single-store division. Given the above, the merged groups' profit writes now

$$4\Pi_{ind} = 4\left(2 \cdot \int_0^{1/2} \left(\frac{a-(1/2-x)}{6}\right)^2 dx\right) = \frac{1}{9}a^2 - \frac{1}{18}a + \frac{1}{108} \tag{3.10}$$

This expression is evaluated for the same demand parameter values as before, and the results are reported in Table 3.5 below:

Table 3.5: Complete divisionalization profit

a	1.5	2	2.5	3	3.5	4	4.5	5	6
$4\Pi_{ind}$	0.17593	0.34259	0.56481	0.84259	1.1759	1.5648	2.0093	2.5093	3.6759

Optimality of partial divisionalization

At this point we compare the profitability of partial and complete divisionalization, as well as that of consolidation (merger). Table 3.6 below presents this comparison for the above-retained values of the demand parameter:

Table 3.6: Profitability comparison between: consolidation, partial and total divisionalization

a	$\Pi_{1,2} + \Pi_{3,4}$		$\Pi^M_{1,2,3,4}$		$4\Pi_{ind}$
1.5	0.28718	<	0.29644	>	0.17593
2	0.50576	>	0.50474	>	0.34259
2.5	0.78689	>	0.76861	>	0.56481
3	1.1306	>	1.088	>	0.84259
3.5	1.5368	>	1.463	>	1.1759
4	2.0055	>	1.8936	>	1.5648
4.5	2.5367	>	2.3797	>	2.0093
5	3.1304	>	2.9213	>	2.5093
6	4.5054	>	4.17113	>	3.6759

In other words, we find that $(\Pi_{1,2} + \Pi_{3,4}) > \Pi^M_{1,2,3,4}$ for any $a > 1.5$. The comparison is unambiguous: *for all but the lowest values of the demand parameter, partial integration is more profitable than centralized decision-making.* The partial divisionalization equally turns out to be always more profitable than total divisionalization: $(\Pi_{1,2} + \Pi_{3,4}) > 4\Pi_{ind}$. Moreover, comparing the profit for the group from running independently the four affiliates, $4\Pi_{ind}$, with that following consolidation, $\Pi^M_{1,2,3,4}$, we obtain that the complete spin-off is actually not profitable here: $\Pi^M_{1,2,3,4} > 4\Pi_{ind}$ always.

To sum up, *partial integration is more profitable than both total integration and total divisionalization.* The intuition is based on the idea that the partial integration strikes a balance between two opposing profit-oriented strategies for the merged firm.

From the production decision point of view, by running independent divisions, the merged entity is able to reduce the business stealing effect induced at every location x by the strategic substitutability, because it credibly commits to not contracting its output. But due to the spatial setting, total divisionalization cannot be optimal, since it would waste any efficiency gains from relocation, given that each independent affiliate would locate at the market center, just like the outsider. On the other hand, consolidation of outlets was shown to be profitable, precisely because the locational advantage it provides w.r.t. the distant demand located at the endpoints, and this despite the output contraction it implies throughout the set of local markets. However, the resulting spatial pattern allows the outsider to enjoy a net location advantage at the market center. To put it differently, having too many consolidated outlets per half-segment can spoil the location advantage.

We find that having only one store on each side of the market center is better, to the extent that this still ensures a lower marginal delivery cost at the market borders, but the outlet location closer to the market center also reduces the outsider's marginal delivery cost advantage for middle locations. This positive relocation effect enhances the reduction of business stealing, and justifies the optimality of this partial spin-off, which allows the merged entity to benefit from the advantages of both strategies. This is the intuition behind the optimality of partial divisionalization[22], i.e. running two independent

[22] In a nonspatial model with differentiated products ans Cournot competition, Yuan (1999) finds that parent firms have a unilateral incentive to restrict their divisions from further spin-offs, because this would

two-store divisions, in our spatial setting.

The only exception occurs for the lowest values of the demand parameter (a in the neighbourhood of 1.5). For such a very low demand, the location advantage of having a store very close to the market border is overwhelming, thus justifying the profitability of the integration strategy. However, this is always the case with spatial Cournot mergers, which become less and less profitable when the demand parameter increases[23].

A closer look at the comparison between the total pre-merger profit of the merging partners and the group's profit with partial divisionalization reveals that *the subsequent partial spin-off is always profitable for the two initial merger participants, even when merger is not, namely for the higher values of the demand parameter* ($a > 3$) - see Table 3.7 below:

Table 3.7: Comparison between pre-merger and partial divisionalization profits

a	1.5	2	2.5	3	3.5	4	4.5	5	6
$\Pi_{1,2,3} + \Pi_4$	0.27663	0.48481	0.75554	1.0888	1.4846	1.9429	2.4637	3.0470	4.4011
$\Pi_{1,2} + \Pi_{3,4}$	0.28718	0.50576	0.78689	1.1306	1.5368	2.0055	2.5367	3.1304	4.5054

In other words, it can be profitable for firms to merge unprofitably but spin off afterwards and thereby increase their profits. Given the profitability doubts raised by mergers, this suggests that unprofitable mergers may occur because they provide firms with the opportunity to (more) profitably spin off or divest afterwards.

Remark: *The example constructed to argue this idea is not unique. Appendix B shows that the same results obtain if we allow for the case where the remaining rival (the outsider) operates two stores instead of a single one.*

3.2.3 Divestiture

Spin-offs are basically transfers of property rights on the firm's assets, just like structural merger remedies. Our framework lends itself therefore to an interpretation in terms of divestitures. Given the above results of the profitability comparison between merger

ultimately lead to total profit dissipation within the perfectly competitive equilibrium.

[23] When a increases, the gain of market shares at distant locations becomes relatively less important, whereas the loss of market shares at the other locations weighs more and more. More generally, the profitability of horizontal takeovers in a Cournot setting with cost asymmetries decreases with market size - see Fauli-Oller (2000).

and spin-off/divestiture, our framework illustrates a situation where mandatory asset sales might actually improve merger profitability instead of reducing it, even when they fulfill their corrective role.

Price analysis

To support this idea, we briefly discuss the price effect of the merger. Rather extensive computations are necessary, and are summarized in Appendix B, but the outline of the comparison is the following.

Since independent Cournot equilibria obtain for each local market $x \in [0, 1]$, basically at each point on the segment an equilibrium price obtains, function of the aggregate output delivered at that point. Because firms deliver individual output within their own market area, intervals of local markets can be defined over which the same firms deliver output. For a given set of firms supplying over a given interval on the segment, the price expression is uniquely defined. Therefore, in order to assess the price changes, first we need to identify these different subsets of local markets (intervals within the segment) to which the same price expression corresponds. For that, the market areas[24] for all stores need to be determined, for every spatial equilibrium considered (before merger, after centralizing merger, and after partial divisionalization/divestiture). To obtain the price change prompted by the switch from one spatial market equilibrium to another, attention must be paid to the appropriate subset of local markets over which the price (either before or after the change) is defined by the same expression[25].

A first price comparison at every local market on the segment reveals that *the merger to duopoly is everywhere anticompetitive*, i.e. it leads to a price increase throughout the set of spatial markets. This motivates the use of asset sales as a merger remedy, because in such cases, merger control authorities typically require an asset transfer to remedy the competitive harm. Divestitures are meant to make the market structure more symmetric, and thus enhance competitive pressure exerted on the merged entity, preventing therefore

[24] For a single-store firm, the market area covers the segment, and is centered around the midpoint. For an outlet belonging to a multi-store firm, the market area spans on each side halfway to the next outlet owned by the same firm.

[25] See Appendix B for the details on price computations.

the price-raise effect of the merger.

In our framework, the market entry through the take over of the two divested affiliates yields the same market structure and spatial pattern as the partial spin-off. In other words, the partial divisionalization and the take-over by a new entrant of two stores are equivalent from the point of view of market outcome. Comparing the market price after such a take-over with that following the merger, we obtain that *the divestiture lowers the price at every local market on the segment.* It would therefore be declared successful by the merger control authority[26]. Nevertheless, we have seen that at the same time it improves merger profitability, through the revenue from the sale of the two affiliates[27].

Interestingly enough, this comes down to illustrating a case for an effective merger remedy being designed and proposed by the merging firms[28]. More importantly though, our theoretical example draws attention to the extent to which remedies may prove costly (or rather not) to merging firms.

3.3 Conclusion

This chapter addresses the issue of profitable spin-off following a horizontal merger in a spatial Cournot framework. Merging and spin-off are opposite strategies for firms, and under standard linearity hypotheses they are not simultaneously profitable. Here, merging and completely integrating affiliates is indeed profitable, thanks to efficiency gains from

[26] Moreover, the price comparison between the market structure before merger and the one after divestiture equally shows that the latter reduces the average price. To be precise, the only markets where price goes up after divestiture are those in the close neighborhood of 1/2. Nevertheless, further computation reveals that the total positive effect on all other consumers exceeds the consumer loss for these central markets, so the divestiture has a net positive overall effect. Actually, this means that the divestiture is 'overfixing', i.e. it goes beyond its corrective purpose, by raising consumer surplus as compared with the pre-merger situation.

[27] Note however that the implicit assumption is that the merged entity cashes in the maximum willingness to pay of the new entrant, but this is rather a standard assumption, which can be justified by the fact that the divestiture represents an opportunity to enter the market for the external firm, therefore the bargaining power lies with the incumbent.

[28] In contrast, Cabral (2003) devised a spatial competition model à la Salop in which consumer welfare is lower when asset sales, as chosen by the merging parties, take place.

relocation. Nevertheless, the subsequent spin-off is even more profitable. However, that does not mean operating completely independent outlets, but just partially divisionalizing into multi-store divisions. This still allows the group to benefit from the relocation advantage, but also represents a commitment to increase output at every local market.

To a certain extent, the spatial framework allows here the identification of a possible rationale for mergers (regardless of their internal profitability), namely the opportunity to profitably divisionalize afterwards. Finally, since the market outcome is actually the same as after a divestiture to a new entrant, our example illustrates a particular impact of structural remedies on merger profitability. Divestitures, even when they do restore competition, may actually increase merger profitability. The effect is all the more outstanding when the merger is not only anticompetitive (so the remedy is necessary), but also unprofitable in the beginning.

Part II

DESIGNING MERGER CONTROL

This second part of the dissertation will concentrate on the strategic interaction between the merging partners and the competition authorities in light of their respective individual incentives concerning the merger consequences and merger control outcome. Chapter 4 will introduce the topic by reviewing the challenges facing both the practice and the theory of merger control on account of this interaction. Chapters 5 and 6 provide formal models of merger control in a context of asymmetric information with respect to the merger's competitive effect. Chapter 5 examines in this framework the optimal merger control given the application of merger remedies to regulate mergers and that of the 'efficiency defence' to assess them. Chapter 6 studies the design of divestiture contracts in this setting and proposes a revelation mechanism within merger control to eliminate the asymmetric information problem.

Chapter 4

A Critical Appraisal of the Theory and Practice of the Assessment of Merger Efficiencies and of the Application of Merger Remedies

The monopolist needed a sedative,

The trust-busters' cries were repetitive:

'Your market share rose

When you bought all your foes;

In a word, you are anticompetitive!'

(Anticompetitive, by Tim Alborn)

4.1 Introduction

"In giving an *unconditional* green light to Whirlpool's takeover of Maytag, US antitrust authorities have basically said that no deal, whatever the market share combined, will henceforth be forced to make even minor concessions. The $1.7 billion deal between the two appliances makers will create not only the biggest company in its segment worldwide, it will also control around 70% of the US market for washer and dryers." (Oligopoly Watch, March 30, 2006).

In discussing the decision, the Financial Times ("Whirlpool takeover of Maytag approved", March 30, 2006) quotes Thomas Barnett, the head of the antitrust division, who did however say that "the deal would not 'substantially' reduce competition, was 'not likely' to harm consumer welfare, and was 'not likely' to give the merged entity market power in the sale of any of its products."

This goes against the view according to which the current merger wave is expected to raise important anti-competitive concerns, higher than the last one did. A last year editorial in Business Week ("Here Comes the Year of the Deal", October 10, 2005) observed that not only is there increased pricing power in fewer hands, but there is also a slowdown in entrepreneurship, so there is no offsetting movement from up-from-nowhere companies. As the Business Week article puts it: "The downside of consolidation was less apparent during the mergers and acquisitions boom of the 1990s, since acquisitions and consolidations were balanced out by an equal amount of business formation. New companies such as Yahoo! Inc. and eBay Inc. became formidable competitors to existing businesses. This time, however, there's no sign of a similar surge of startups leavening the economy."

In other words, without some countervailing force, horizontal concentration leads to increased market power in fewer hands, which is what antitrust basically tries to avoid. It has been long recognized that in an unregulated market, social and individual incentives to merge can widely differ. This is why certain mergers have to be first checked by independent bodies, such as the Federal Trade Commission in the US, or the Commission in the European Union. They are in charge of 'merger control', which fundamentally consists of answering two questions: does the merger pose a threat for competition? and

if so, how can that threat be best eliminated?

The answer to the former is the merger assessment process, which requires to process all available information for the purpose of establishing the competitive effect of the merger. To answer the latter question, competition agencies can resort either to downright prohibitions (scarcely ever, though), or to merger remedies. The acknowledgment of a merger's potential efficiencies and the generalized use of remedies to control the final market outcome have become central to this two-stage process, due to the more economics-inspired turn gradually taken by most merger policies. *This chapter will provide a critical analysis of both the application and the theoretical underpinnings of these two practices. Constant focus will be kept on information asymmetry and conflicting incentives as the main origins of the problems raised in practice, as well as in theory, by the assessment and regulation of mergers.*

To do so, we discuss next the merger assessment process. First we present its unfolding in practice, so as to pin down the problems affecting the efficiencies' treatment, and to take stock of the practical manner of dealing with it. We examine then the theoretical justifications for the latter, and go on to look into the merger control enforcement. We review the policy and practice of merger remedies as the main merger control instrument, and check against the available evidence and the recommendations of the theoretical models on the design and implementation of merger control.

4.2 Scope and unfolding of merger control

Merger control can be defined as the ability by the state to block or modify a merger that is considered undesirable according to some (legal) criterion. More generally, it is part of the competition policy, which in its turn represents a "set of policies and laws which ensure that competition in the marketplace is not restricted in such a way as to reduce economic welfare" (Motta (2004, p.30)). Actually, merger control represents a particular antitrust area, inasmuch as it requires the assessment of future market structure and behaviour, instead of sanctioning past conduct (see for instance Encaoua and Guesnerie (2006, p. 93)) and as such, it is the competition policy branch closest to regulation.

The US merger regulation preceded the other countries'. The Sherman Act of 1890 only covered price fixing and market sharing agreements between independent firms as anti-trust violations, so in 1914 the Clayton Act was passed to extend anti-trust legislation to mergers likely to reduce competition. It was later several times amended, last by the Hart-Scott-Rodino Act of 1976, which granted the Federal Trade Commission (FTC) and the Department of Justice (DoJ) the power to investigate mergers above a certain size threshold. These two agencies share in the US the responsibility of anti-trust, and thereby that of merger control enforcement (at the federal level). The merger control policy and procedure are given in the Horizontal Merger Guidelines (jointly issued April 2, 1992 and revised April 8, 1997).

The European Community Merger Regulation (ECMR) was first adopted under the form of the Council Regulation 4046/89 of December 1989, and came into force on September 21, 1990, providing within the European Community law a legal framework for the systematic review of mergers and other forms of market concentrations. The ECMR was amended in 1997 and thoroughly revised in 2004, and builds on four fundamental principles: the exclusive competence of the Commission to review concentrations of Community dimension, the mandatory notification of such concentrations, the application of market-oriented, competition-based criteria, and the provision of legal certainty through rapid decision-making. Similarly, Horizontal Guidelines were issued in Europe for the assessment of mergers[1].

Actually, whatever the relevant jurisdiction applying to a specific merger, the unfolding of the merger policy is basically the same. There are always four stages in its application, which Lyons (2004) lists as follows: (1) the decision whether to review/investigate the merger, (2) the merger review/assessment, (3) the decision to accept, prohibit or require remedies, and (4) the appeal.

In the US, stages 1 and 2 are concentrated in the hands of the two relevant competition agencies, the FTC and the DoJ. At stage 3 they submit their analysis to a court of justice for a preliminary injunction. In turn, in the EU stages 1, 2 and 3 are concentrated in the

[1] Guidelines on the assessment of horizontal mergers under the Council Regulation on the control of concentrations between undertakings, Official Journal (2004) C 31/5.

hands of the Directorate General Competition (DG Comp). The role of the courts in Europe has been typically limited to a formal and not substantial control of the commission's decision[2].

Once a given merger qualifies, due to the size criterion (sales, basically), for investigation by the relevant competition agency, the ensuing merger assessment to determine the market power impact begins with the delineation of the relevant market in both product and geographic terms - in short, the set of products and geographical areas to which the products of the merging firms belong. Central to the product market definition is the SSNIP test[3] ("small but significant non-transitory increase in price"), implemented through price elasticities and price correlation analyses. Eventually, the seasonal, multiple or secondary markets may be considered, as the case may be. Similarly, for the geographic market delineation, the agency needs to also take into account transportation costs, importations, or the existence of submarkets.

Based on the market definition thus established, the initial screens applied to determine the potential antitrust concern involve some numerical thresholds as to the levels of concentration and increases in such concentration that raise potential competitive concerns. These thresholds build on the Herfindahl-Hirschman Index (HHI), which, together with the market shares, are used as market concentration measures to assess whether the merger gives rise to unilateral anti-competitive effects[4]. The check-list for the latter

[2] However, in the last years some very controversial cases (both prohibitions - the three cases concerned were Airtours/First Choice, Schneider/Legrand and Tetra Laval/Sidel, and acceptance cases - the Sony/BMG case), were overturned by the Court of First Instance and, in second instance, by the European Court of Justice.

[3] Introduced by the US DoJ, and currently used by anti-trust authoritites worldwide; also called the Hypothetical Monopolist test. See the US Horizontal Merger Guidelines.

[4] The motivation for this is actually based on the static Cournot model, and was rationalized for instance by Dansby and Willig (1979), who establish that the Herfindahl index, defined as the sum of the squares of firms' market shares, is related to the average industry mark-up and possibly to total welfare (provided marginal costs are constant). Farrell and Shapiro (1990,a) and Levin (1990) derive sufficient conditions for a merger to increase welfare based on firms' market shares. The latter supply relevant information to the extent that in Cournot markets they are negatively correlated with marginal costs. Although this does not take into account the fact that market shares cannot be used to predict the post-merger market equilibrium, nor the firms' possibly strategic behaviour after the merger clearance decisions, the Herfindahl

equally comprises the evaluation of mitigating or countervailing forces, such as the buyer power, the timeliness, likelihood, and sufficiency of entry[5], the failing firm defence[6] and the merger's efficiency gains. At the same time, a merger might have pro-collusive effects, so another check-list, for co-ordinated merger effects, needs to be taken into account[7].

4.3 "Does the merger pose a threat to competition?" - The assessment of efficiencies

The US Merger Guidelines state that antitrust agencies "will not challenge a merger if cognizable efficiencies are of a character and magnitude such that the merger is not likely to be anticompetitive in any relevant market. To make the requisite determination, the agency considers whether cognizable efficiencies likely would be sufficient to reverse the merger's potential to harm consumers in the relevant market, e.g. by preventing price increases in that market" (US Merger Guidelines, revised April 8, 1997, §4). In other words, the merger's potential efficiency gains are recognized as a possible countervailing factor w.r.t. the merger's competitive damage. This explicit 'efficiency defence', together with the substantive test for declaring a merger anti-competitive, represented until 2004 the fundamental difference between the US and European merger policies. As Motta (2004) remarks, despite the amended version of 1997, the ECMR was, until 2004, "at odds with economic principles", because the ECMR substantive criterion of dominance did

index is explicitly employed by both the US and the European Merger Guidelines.

[5] The rationale for the mitigating effect of market entry stems in the theory of contestable markets (see Baumol et al. (1998)), which argued that firms' behaviour on a concentrated oligopoly market may be disciplined by potential competitors (i.e. potential new entrants). However, Werden and Froeb (1998) raises doubts as to the possibility of market entry to reduce or eliminate the anti-competitive effects of mergers, and Spector (2003) shows that as long as Cournot competition is relevant, if marginal costs are non-decreasing, then any profitable merger which fails to generate 'synergies' (defined as in Farrell and Shapiro (1990,a) will raise price, irrespective of entry conditions.

[6] Accordingly, a merger increasing market power may be allowed if it is the only means to preserve within the industry the assets of one of the partners which would otherwise exit the market.

[7] The factors affecting collusion typically include symmetric market shares, growing demand, price transparency, symmetric cost structures, product homogeneity, excess capacity and its distribution across the market, multi-market contact, and demand volatility.

not prohibit the welfare-decreasing mergers that did not create or strengthen a dominant position, and on the other hand, there was no room for evaluating efficiency gains, while a merger's economic assessment heavily depends on them[8].

Empirically, this was signalled by Neven and Röller (2002), in a paper on apparent discrepancies between EU merger decisions and stock market's anticipations of the anti-competitive consequences of these concentrations. Based on a sample of 100 mergers, some of the factors that may account for such discrepancies were examined. Overall, the study finds a low frequency of type I discrepancies (instances where the Commission had prohibited a merger that the market had anticipated as being pro-competitive), but a high frequency of type II discrepancies (situations where the Commission failed to block or to impose remedies on mergers that the market had anticipated to be anti-competitive)[9]. According to this analysis, the errors would have been explained by the scope of the dominance criterion, the lack of an explicit efficiency defence or the political economy of merger control (the Commission pursuing other objectives than those it had been assigned).

All in all, the thorough revision of the ECMR replaced the former market dominance prohibition criterion with a "significant impediment to effective competition" substantive test, and fully acknowledges now the necessity to take into account merger efficiencies. This enabled a substantial harmonization of European merger policy with the US one[10], but also with the economic principles[11].

[8] Actually, the Commission interpreted the Art.2.1.(b) of the old ECMR (under which "it may take account of the development of technical and economic progress only to the extent that it is to consumers' advantage and does not form an obstacle to competition") as allowing no practical scope for an efficiency defence once a dominant position was reckoned to be created or strengthened: "The creation of a dominant position in the relevant markets identified above means that the efficiencies argument put forward by the parties cannot be taken into account in the assessment of the present merger."

[9] Duso et al. (2003) equally study whether the EU merger procedures are prone to systematic errors, and find in turn (based on a sample of 164 EU merger control decisions) type I errors in 28% of cases and type II errors in 23% of them.

[10] For which the substantive prohibition criterion is the "substantial lessening of competition".

[11] Although the above-mentioned check-list elements are typically ordered in the presentations of merger policy by the various competition agencies, the merger review actually follows an integrated approach. Competition authorities do not apply their respective guidelines as a linear, step-by-step progression, that invariably starts with market definition and ends with efficiencies or failing firm defence. The analysis of

4.3.1 Treatment of efficiencies in practice

Before dealing with the insights provided by economic theory, we first present the way efficiency gains are accounted for in practice, so as to highlight the challenges facing competition authorities.

The evidence on whether mergers really generate efficiency gains is not direct but rather deductive, as such gains are quite controversial (besides being difficult to estimate). While many studies (starting with Ravenscraft and Scherer (1987) for instance) find little support for a positive relationship between mergers and efficiencies, Gügler et al. (2003) conclude that 29.1% of the mergers examined generated efficiency gains (as suggested by the finding that they experienced an increase in both profits and sales). Actually, there appears mostly to be a consensus, reached from both case studies and casual observation, that although some mergers were indeed successful in securing substantial synergies, this outcome is subject to an important variability[12].

Given this foggy picture of efficiencies obtained through mergers, the problems raised by their actual assessment in practice cannot be surprising. According to Ilzkovitz and Meiklejohn (2001), these problems cluster around the following points: the choice of the relevant welfare standard, the calculation of the minimum required efficiency gains, the measurement of efficiencies, the burden of proof and finally their verification.

To start with, under both the EU and US merger laws, competition agencies only consider consumers' welfare when it comes to the assessment of efficiency gains. In the next section we provide some economic motivations for this choice, but it should be noted that it is essentially a political one. Basically, the consumer welfare criterion is favoured when it is believed that competition authorities should avoid trading off the welfare of one group of agents against that of another (consumers and firms, share-holding consumers and consumers not possessing shares). Under this criterion, the efficiency defence is accepted

efficiencies, in particular, does not occur "after" the (anti)competitive effects assessment, but at the same time. The assessment of efficiencies is not sequential, because all factors are to be considered and balanced before a decision is made whether the merger significantly impedes competition.

[12] See Röller et al. (2001) for a review of the empirical studies on mergers and their consequences. The article does note that the number of empirical studies of the effects of mergers on prices through eventual efficiency gains is surprisingly small.

only where the nature and size of the efficiency gains are such that, even with reduced competition in the market, the consumer will be no worse off than before the merger[13].

Based on the consumer welfare standard, the minimum required efficiencies are those that just compensate the consumer welfare loss due to the merger's anti-competitive effects. Implicitly, the size of the efficiency gains needed to justify such a merger depends on the size of the anti-competitive effects. To assess the required efficiency gains, in practice a simulation analysis is performed, which needs to specify not only the appropriate mode and intensity of competition both before and after merger (so as to evaluate the competitive damage), but also the so-called pass-on rate, which gives the proportion of cost-savings which will be passed on to consumers given the prevailing market structure and price-elasticity of demand. Ilzkovitz and Meiklejohn (2001) note that any application of the efficiency defence based on the consumer welfare standard requires a simulation analysis allowing to estimate simultaneously the price increase in the absence of efficiencies and the degree of pass-on[14].

To estimate efficiencies, one must first identify them. To properly define the relevant efficiencies, it is important to note that not all kind of cost savings equally enhance competition, nor improve consumer welfare. From an economic point of view, it is necessary to distinguish between efficiencies that lower marginal costs, and efficiencies that reduce fixed costs, because only the former can have an impact on consumer welfare[15]. Furthermore, among the marginal cost savings, Farrell and Shapiro (2000) claim that 'synergies' are those truly relevant for the efficiency defence[16]. They cannot be achieved by one firm unilaterally without the merger, and require the "integration of the parties' unique, hard-to-trade assets...[as well as] the cooperation and coordination of the two firms' as-

[13] Nevertheless, a trade-off might still occur, typically if the merger affects more than one market. Thus, if the anti-competitive effects and the efficiencies are distributed differently between the markets, this can raise the question whether benefits to one set of consumers should be weighed against harm to another set of consumers.

[14] See Werden and Froeb (1996) for such a technique, and Röller et al. (2001) for the suggestion to assess the price increase absent any efficiency gains, in a so-called 'worst case scenario'.

[15] Röller et al. (2001, p.42-49) provide a very detailed typology of merger efficiency gains

[16] Farrell and Shapiro (1990,a) show in the widely used Cournot framework that synergies benefit consumers, in contrast with other cost reductions.

sets that allow production on a superior production function, as distinct from causing different choices (such as scale) on a fixed production function. In other words, synergies allow output/cost configurations that would not be feasible otherwise"[17]. Implicitly, this highlights the additional requirement of merger-specificity, according to which the relevant efficiencies to be taken into account cannot be obtained without the merger, through other (less anti-competitive) business strategies. This merger specificity requirement within the efficiency defence (basically, the need to answer 'Why this deal? Why not another?') is not merely a supplementary constraint laid against the merging parties, but is actually meant to provide the competition authority with insight into the very business rationale for the transaction under review.

Still, it is up to the merging firms to demonstrate the merger-specificity of the claimed efficiencies. Merger regulation clearly acknowledge that "Efficiencies are difficult to verify, in part because much of the information relating to efficiencies is uniquely in the possession of the merging firms" (US DoJ and FTC, Revision to Merger Guidelines 1997, §4). On account of this information asymmetry, the burden of proof falls to the lot of the merging firms. Typically, merging firms are expected to be able to explain how, when, and at what cost the efficiencies will be achieved, why they are merger-specific, the likelihood and magnitude of claimed efficiencies likely to result from the merger, and how the efficiencies will affect the merged firm's ability or incentive to compete. Nevertheless, this raises further problems, such as the standard of proof to require, how to check the validity of the firm's assertions, whether and how to check *ex post* if the efficiency gains announced by the merging firms have really been achieved and whether they have been passed on to consumers. It has been argued for instance that since the ex-ante assessment is subject to so much uncertainty, the antitrust authority should carry out an ex-post audit to determine whether efficiencies have really materialized and been passed on to consumers, and if this is not the case, the authority should obtain appropriate remedies to restore competitive conditions (Brodley (1996)). Röller et al. (2001) quote this proposition for

[17] In contrast, a no-synergies merger is one in which the merged entity's outputs, prices and total costs were feasible for the parties pre-merger, with different competitive behavior but without deep changes in production. Therefore, it is not generally a synergy to achieve economies of scale, because firms could unilaterally expand to do so.

the record, but note that approving mergers only on a temporary basis, as Scherer (1991) had already suggested before, would most likely involve prohibitive costs[18]. Nevertheless, a related, and quite effective approach, though by not means generalized, has actually been 'experimented' in the US. Brodley (1996) quotes a hospital merger case[19] where the consent decree negotiated between the parties and the Attorney General provided that the merging parties pay to the Treasury the shortfall from the alleged efficiencies, if the latter do not materialize and benefit patients within five years. The merits of such a bonding procedure lie with the explicit consideration of both the merger's external effect on consumers and the information asymmetry between the agency and the parties with this respect. The moral is that it would be helpful to devise some revelation mechanism to screen efficiency claims. The next section takes stock on the theoretical propositions available, and more generally on the contributions to the economic analysis of efficiency gains.

4.3.2 The economic analysis of merger efficiencies

To start with, the theory explains the rationale for taking into account the efficiency gains from mergers. This can be traced back to Williamson (1968), who balanced the allocative inefficiency of increased market power against what the US Merger Guidelines (as revised in 1997) call "... the primary benefit of mergers to the economy [which is] their potential to generate ... efficiencies".

However, Williamson's market power vs. efficiencies trade-off was set in a total welfare framework, in which the loss of consumer surplus due to higher prices can be (more than) compensated by an increase in producer profits, whereas currently competition

[18] Although this idea draws attention to the fact that firms may lack the incentives to undertake the thorough restructuring needed to achieve the alleged efficiencies once the authority's approval has been secured, it is not always possible to implement ex-post remedies (under the European law, the Commission cannot break up a company), and it might be downright impossible to 'unscramble' the firms' assets years after the merger, not to mention the cost of it, especially if merging involved sunk costs in the first place. The business uncertainty caused by such measures goes against the acknowledged objective of competition authoritities to provide a stable and certain legal environment for merger regulation.

[19] The case Pennsylvania vs. Providence Health Sys., Inc., quoted by O'Connor (1995).

authorities focus on the merger's impact on consumers' surplus in order to assess the necessary efficiencies for the merger to be cleared. This has been justified in several ways.

In a price-setting spatial product differentiation model, Lyons (2002) finds that there are situations where the consumer surplus standard leads to a higher total welfare than the direct application of the total welfare standard. Basically, under the less demanding total welfare standard, an acceptable merger actually prevents future efficiency-driven takeovers, and thereby thwarts more competitive future market structures. Besanko and Spulber (1993) equally found that the optimal decision rule for merger approval should be biased in favour of consumer surplus, in a model with regulatory failure due to the asymmetric information advantage of merging parties vis-à-vis the agency w.r.t. the merger's cost savings. Again, the outcome in terms of expected social welfare is actually higher when the challenge decision is made under the stricter criterion. Neven and Röller (2005) compare the performance of the two standards in the presence of regulatory failures due to lobbying on behalf of merging parties and their rivals. This model finds that under the total welfare standard, lobbying leads to type II errors, whereas under the consumer surplus standard, it reduces the occurrence of type I errors (more likely under this stricter criterion), although at a cost in terms of real resources. Thus placing more weight on consumer surplus is rationalized in presence of lobbying activities. Farrell (2003) also obtains that even if total surplus is the true regulatory goal, the agency should focus on consumer surplus, but on account of the presence of litigation/negotiation costs within the merger control process. Farrell (2003) notes that in the bargaining, merging firms already represent their own efficiency interests in their profits, therefore to avoid the double-weighing of firms' interest in the merger efficiency claims, different from those 'required' for consumers, the agency should focus on the latter's welfare.

Doing so means to conduct a merger assessment based on 'half' of its external effect, given that non merged firms are equally affected by the concentration. Farrell and Shapiro (1990,a) provided a pioneering contribution from this point of view, but showed as well that for a Cournot merger to benefit consumers through lower prices, the efficiency gains need to materialize as synergies. This rather strict requirement is somewhat disproved by Häckner and Razo (2004) by considering price-competition markets facing congestion. In

such cases, horizontal mergers may induce firms to use capacity more efficiently, which may put considerable competitive pressure on the industry resulting in price reductions. Incidentally, this means that in congested markets agencies should focus less on 'synergies', lest they should prevent consumer surplus improvements. The synergy requirement is further relaxed by Stennek (2001), by taking into account the asymmetric information issue. Since oligopolistic competition on concentrated markets does not induce a cost-minimizing allocation of production among firms, mergers can generate efficiency gains associated with the pooling of private information on own costs, thereby allowing an efficient production rationalization (although without synergies à la Farrell and Shapiro (1990,a)). Consumers stand to gain both from a lower price and a lower price variability. Amir et al. (2004) equally exploit the information asymmetry between the industry firms w.r.t. the ability of merging firms to achieve the efficiency gains. At the Bayesian Cournot equilibrium of this model, the merger is profitable and can even increase consumer surplus as long as non-merged rivals believe with a sufficient probability that the new entity will generate high enough cost-savings, even if ex-post none actually materialize.

These models accounting for the information asymmetry among industry firms highlight only part of the consequences due to the efficiencies' uncertainty. To account for the other part, the relationship between the regulator and the merging firms needs to be considered.

Choné and Linnemer (2006) examine some consequences of the uncertainty about the merger's efficiency gains. They find that although the competition authority should be cautious about random efficiencies, simply dismissing them from the merger assessment on account of their uncertainty cannot be economically founded. Furthermore, the stand that the agency should take regarding the efficiencies depends on the curvature of the social objective function. More precisely, for the widely used case of linear demand, both consumer surplus and industry firms' profits are convex in efficiencies, making the competition authority actually welcome the uncertainty in the merger assessment. Along a different line, Banal-Estanol et al. (2006) analyses the effects of investment decisions and firms' internal organization on the efficiency gains of horizontal mergers. In a framework with endogenous efficiencies, the welfare results of the paper suggest that antitrust authorities

may approve welfare-reducing mergers (type II error) and block welfare-enhancing mergers (type I error) if they take for granted that potential efficiency gains will be effectively realized.

These conclusions are drawn from static models. Further insight is provided by a dynamic view of the regulatory relationship between the competition authority and the merging firms from the standpoint of efficiencies. Motta and Vasconcelos (2005) for instance show that the 'efficiency offence' argument[20] cannot be valid as long as the competition authority adopts a forward looking behaviour. More precisely, a forward looking agency anticipates the market structure that a given merger will lead to, and as such will not block a merger triggering a subsequent efficiency-driven take-over. In contrast, a myopic authority would ban the first concentration as soon as it threatens a rival with market exit. As a result, outsiders neither exit the market, nor react by undertaking the subsequent efficient merger, and thus the eventual consumer surplus improvement is actually forgone. By the same token, Razo (2004) examines how the decision-making is affected if the agency takes into account alternative future mergers, and to start with, he confirms that this cannot lower consumers' welfare. He argues that the merger policy might become stricter as compared with the case where future alternative mergers are overlooked, because the competition authority requires higher efficiencies than simply those needed to restore pre-merger consumers' welfare. As a result, some price-reducing mergers will be banned. In addition, the toughness of the merger policy depends on the agency's beliefs w.r.t. the levels of efficiencies that can be achieved through mergers. If it believes these efficiency gains to be high, then it might block welfare-increasing mergers which only promises low efficiencies, in order to wait for one which will lead to higher efficiencies. As a consequence, Razo (2004) finds that the more uncertain the synergies, the stricter the merger policy will become, which incidentally goes against the static framework result of Choné and Linnemer (2006).

In light of these consequences of the information asymmetry w.r.t. efficiency gains, one

[20] Basically, this states that the efficiency gains can turn out to be detrimental if they make the merged entity so tough and agressive a competitor as to drive out rivals from the market, as a result of which consumer surplus drops.

could wonder what has been concluded on the ways either to alleviate or to completely eliminate this information constraint.

In practice the assessment of efficiencies closely follows the theory as far as the burden of proof of alleged efficiency gains goes. Gonzalez (2004) investigates how antitrust agencies should structure the disclosing of information about efficiency gains from interested parties (merging firms and competitors) in merger control. He obtains that the burden of proof for efficiencies should fall to the lot of insiders, whereas the burden of proof for an eventual efficiency offence should fall to that of competitors.

At this point it must be recalled that arguing efficiency gains and assessing the validity of these claims necessarily yields a substantial increase in administrative procedure costs for both firms and competition agency (see Ilzkovitz and Meiklejohn (2001) for a review of the debate on the associated implementation costs). An important argument against the efficiency defence is the possibly prohibitive cost of information acquisition due precisely to the context of asymmetric information. Lagerlöf and Heidhues (2005) explicitly deal with this issue, and identify the conditions under which the cost trade-off does warrant the taking into account of efficiency gains. Their results claim that the efficiency defence is not worth while if it is too costly for society as a whole, through the evidence production costs it entails on behalf of the merging firms. However, their model does not consider the possibility of information manipulation or cheating on behalf of merging firms that unrightfully argue efficiencies. Medvedev (2004,b) addresses this topic and explains the presence of a fuzzy approval rule (i.e. approval probabilities varying between zero and one), by means of a signalling game where the CA clears mergers with some positive probability, based on its observation of both the evidence supporting the efficiencies claims, but also of the way it is produced (i.e. the costly effort to produce the evidence).

By explicitly taking into account the strategic behaviour around the efficiency gains given the associated information asymmetry, in theory this problem could be eliminated. This requires some revelation mechanism which would enable the screening of mergers (or rather, of the efficiency claims). Faulli-Oller and Corchon (1999) explicitly study the implementation of socially optimal mergers when merging firms have privileged information on the potential efficiency gains, but find that standard tools of dominant strategy

implementation (such as the Vickrey-Clarke-Groves mechanism) cannot apply.

A different approach, making use of contract theory, is taken by Gonzalez (2003), who proposes a revelation mechanism for screening mergers, based on two instruments: the divestiture and the choice of the market on which it will take place. The mechanism is inspired by the intuition that the merger remedies can be used as a utility transfer to reveal the merger's type within a standard menu of contracts. The same is implied by the remark in Röller et al. (2001, p.116) that "a different approach to screening mergers would be to implement a revelation mechanism through the institution of merger licence fees to be paid to the government". Chapter 6 of this dissertation proposes an alternative screening mechanism, also based on merger remedy, but in which the revealing 'licence' takes the form of the sale price the merging firms agree to receive from the asset buyer.

Although screening mechanisms are not yet applied in practice, such theoretical propositions do highlight the role of private incentives for the ultimate outcome of the efficiencies assessment, as well as the close relationship between efficiency gains and the regulatory response consisting of merger remedies.

4.4 "How can the competition threat be best eliminated?" - An analysis of merger remedies

At the end of the merger review process/stage, the CA can make one of the following three decisions: clear the merger, reject it, or accept it subject to conditions. This last possibility involves the application of merger remedies, which comes down to enlarging the toolbox available for merger regulation by granting competition authorities greater latitude in making merger control decisions.

Merger remedies are generically defined as commitments, offered by the merging firms or possibly required by the CA, which address the competitive concern raised by the merger, and are destined to restore market competition and prevent the merger's negative impact.

They generally fall into two broad categories, either structural or behavioural, but sometimes a combination of the two is necessary to restore market competition. Be-

havioural remedies represent limitations of property rights, such as non-discrimination provisions, vertical firewalls, or termination of existing business agreements. In contrast, structural remedies involve the change in the allocation of property rights throughout the industry, by means of asset transfers between the merging parties and some agreed-upon buyer. The hybrid category of quasi-structural remedies comprises mandatory licenses or access rights. Given this range of possible actions as merger remedies, one can and should notice that they enable to a certain extent the 'fine-tuning' of merger control in terms of regulatory response to a proposed merged. Consequently, merger remedies have shifted the focus of merger control closer to market regulation[21]. As such, their application is subject to much the same design and implementation problems as pure regulation instruments. To support this idea, in what follows we first take stock on the policy, practice and outcome of merger remedies.

4.4.1 Taking stock on merger remedies

Anti-competitive mergers get rarely prohibited nowadays, as it appears that competition authorities are quite keen on clearing them subject to commitments. As a representative example, we give next suggestive statistics on the European merger control:

Table 4.1: European Commission merger remedy and prohibition decisions

(September 21, 1990 to September 30, 2006)

	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	Total
Notifications	11	64	59	59	95	110	131	168	224	276	330	335	277	211	247	313	326	3171
Phase I remedies	0	3	4	0	2	3	0	2	12	16	26	11	10	11	12	15	9	138
Phase II remedies	0	3	3	2	2	3	3	7	4	7	12	9	5	6	4	3	4	77
Prohibitions	0	1	0	0	1	2	3	1	2	1	2	5	0	0	1	0	0	19

Source: European Commission, Directorate Competition[22].

Taking into account the 73 phase I merger withdrawals and the 27 phase II ones, one obtains that overall remedies get applied in 7% of notified cases, with only 0.62% of concentrations being refused. Needless to stress, the seemingly weak proportion of

[21] Rey (2003, p.130) points out that "introducing the possibility of remedies...puts the merger cntrol office in a position close to that of an industry-specific regulator". See also Motta et al. (2003).

[22] Available at http://ec.europa.eu/com/competition/mergers/cases/stats.html

remedied mergers actually concerns the most important (in terms of sales and scope) concentrations[23].

The policy and practice

Even though merger remedies are now extensively used, this has not always been the case. As Baer and Redcay (2003) remind, merger remedies received little attention before the American Congress passed the Hart-Scott-Rodino Act (HSR) in 1976. Without mandatory pre-merger notification, US competition agencies learned about deals after their closing, which was often too late to evaluate the antitrust problems and to negotiate remedies. Only if the agency managed to obtain a preliminary injunction did it have time to negotiate a divestiture before the merger partners 'scrambled the eggs' between them. The Congress recognized the need to prevent this in order to make divestitures an effective remedy. Thus, the HSR Act added to Section 7 of the Clayton Act provided US agencies with the legal foundation to stop anticompetitive mergers and negotiate effective remedies. This legal framework was later supplemented by the FTC's Remedies Guidelines and its Best Practices for Merger Remedies, as well as by the DoJ's Antitrust Divestiture Policy Guide to Merger Remedies of 2004.

The practice of remedies in the EU (and in most of the member states) is more recent, their policy emerging after the adoption of a merger policy itself. The European Commission's policy for merger remedies was first published in 2001 in the Commission's Remedies Notice, adopted on December 21, 2000, then the Directorate General Competition published in 2003 the Best Practice Guidelines on remedies. The ECMR (revised in 2004), the remedies notice, and the Best Practice Guidelines provide guidance to the business and legal communities, and set out the general framework on the types of acceptable remedies, the procedure for their submission to the Commission and the requirements for their implementation.

Basically, all competition authorities implementing merger control have at one time or another adopted some guidelines on the application of merger remedies. Beyond this

[23] Front-page remedy-cases were Air France/KLM, Lufthansa/Swiss, or Sanofi-Synthelabo/Aventis, to quote just a few.

policy similarity, there is a wide consensus w.r.t. several commonly accepted principles, which the OECD 2004 report on merger remedies summarized as follows:

"When devising remedies in merger cases, competition authorities should be guided by the following principles: (i) competition authorities should consider remedies only if a threat to competition has been identified; (ii) remedies should be the least restrictive means to effectively eliminate competition concerns; (iii) remedies should address only competition concerns, and should not be used for industrial planning or other non-competition purposes; and (iv) competition authorities should be flexible and creative in devising remedies."

The general interpretation given to these principles is the following. To start with, the application of remedies should be considered only if they are demonstrably necessary, meaning that the competition authority has the burden to prove that the merger under review is anti-competitive (in turn, merging parties have to come up with proposed solutions to the competitive concerns raised by the deal). When deciding whether a proposed remedy is appropriate, the CA will consider its likely effectiveness and associated costs, and will also take into account the principle of proportionality[24]. Yet, thorough effectiveness is not the only feature desired in a remedy. Competition authorities must also strive for timely implementation at minimal cost in terms of institutional resources. While structural remedies usually have an edge over behavioural remedies when it comes to clarity and simplicity, they have a still more obvious edge in lower post-merger monitoring and enforcement costs. As presumed by the structure-conduct-performance paradigm[25], there is a strong causal relationship between the market structure, the firms' conduct and economic performance. Thus, decisions which would alter the market structure would permit the emergence of market behaviours considered to be desirable, from a competition point

[24] The ECMR of 2004 (paragraph 30) is explicit on these points: "commitments should be proportionate to the competition problem and entirely eliminate it."

[25] Developed by the "Harvard tradition" - see Tirole (1988, p.1).

of view, without the necessity of incurring high monitoring costs[26]. All in all, structural remedies, in particular divestitures, are strongly recommended, because by "creating the conditions for the emergence of a new competitive entity or the strengthening of existing ones"[27], they are supposed to fully and timely solve the competitive harm caused by the merger.

To restore competition, a divestiture should involve the sale of an appropriate asset package to a suitable purchaser, through an effective divestiture process. As for any ex-ante market intervention, the impact of remedies is uncertain to some extent. Policy recommendation take this into account, by addressing the possible risks to which divestitures are subject. According to the 2004 consultation document for the UK Competition Commission Guidelines on Divestiture Remedies, these risks fall into three broad categories: composition-, purchaser- and asset-related. The first concerns the scope of the divestiture package, the second involves the identification of a suitable buyer, whereas the third deals with the maintaining of the competitive potential of the divestiture package throughout the divestiture process. The nature of these possible risks requires the application of certain protective measures.

Concerning the divestiture package, there is wide preference in favour of a demonstrably autonomous on-going business unit of one of the merging parties, and against a 'mix-and-match' divestiture (i.e. a mixture of assets from both merging parties) - this preference for "as is" divestitures is supported by the higher success rate of such divestitures reported in the US FTC's 1999 divestitures study. Furthermore, if the parties fail to divest the original asset package, the agencies may resort to 'crown jewel' provisions, which require the divestiture of additional highly marketable assets. To minimize purchaser risks, the choice of buyer should obey criteria such as independence from the merging firms and capability (in terms of financial resources, business expertise and incentives). In addition, the buyer's choice is subject to approval of the competition authority. Actually, the

[26] Depending on the type of monitoring required, behavioural remedies may put the competition authority in the position of being an ongoing regulator. This is especially true of remedies designed to ensure that access to networks or other essential facilities is provided on terms attractive enough to encourage or maintain competition at satisfactory levels.

[27] Mario Monti explaining in 2002 paragraph 13 of the EU Remedies Notice

use of up-front buyers[28] is recommended, allegedly as the "most vital tool in assuring a successful divestiture"[29] (Parker and Balto (2000)). Finally, from the point of view of the actual implementation, monitoring and divestiture trustees are in charge of overseeing the enforcement of the commitments[30], so as to protect the divestiture package and ensure a timely relief.

The evidence

The assessment of the success or failure of remedy policies is questionable, since there are scarcely any public *ex post* studies on the effective implementation of merger remedies. While competition authorities have carried out some case-by-case analyses, the topic has not yet been properly explored.

The pioneering work in this area was the study carried out by the US FTC and published in 1999[31], which was based primarily on interviews with purchasers of divested assets. The study examined the outcome of divestiture orders from 1990 to 1994, and concluded that: (1) 75% of divestitures had succeeded in creating viable operations in the relevant market; (2) purchasers and divesting parties often act according to their own respective interests which are (too) frequently different from those of the competition authority; and (3) divestiture commitments need certain safeguards to ensure their proper

[28] The FTC makes use of this procedure in roughly 60% of the cases in which there is some form of non-behavioural relief (Parker and Balto (2000)). The DoJ favours an analogue of the FTC's up-front buyer requirement, namely the 'fixe-it-first' remedy, which is only different to the extent that it does not require government approval (i.e. a consent decree). For a summary comparison of the FTC and DoJ merger remedies policies and practices, see Baer et al. (2004).

[29] Paragraph 20 of the European Commission's Notice acknowledges this, by stating that in cases where the viability of the remedy package depends to a large degree on the identity of the proposed buyer, an up-front divestiture will be required.

[30] Monitoring trustees are responsible for monitoring four functions: (1) the carve-out of the divested business; (2) overseeing the interim preservation of the divested assets; (3) the holding-separate of the divested business from the parties' retained business; and (4) the parties' divestiture process, including an assessment of the suitability of the purchaser. A divestiture trustee is appointed in case the parties fail to divest on time or if a buyer has not been found. The trustee is then mandated to sell the asset at no minimum price, provided the competition agency approves the final purchaser.

[31] Available at www.ftc.gov/os/1999/08/divestiture.pdf

implementation. In other words, it obtained that about 25% of applied remedies were completely unsuccessful, that divesting firms behave strategically, and that the FTC basically had as poor an information as the buyers who could not prevent the failure of their acquisitions, since the incriminated divestiture and sale agreements had been approved.

However, despite the study's drawbacks[32], mainly that only qualitative information (voluntary answers to interviews and questionnaires) has been used to assess the effects of a limited number (35) of divestiture orders, it appears that the FTC learned its lesson, and in 2003 it published its Best Practices statement for negotiating merger remedies, which basically contains the very protective measures listed in the previous section for determining which assets are to be divested, identifying an acceptable buyer, and the provisions to include in a divestiture agreement. By the same token, the EU 2001 Remedies Notice openly lists the same policy recommendations distilled from the results of the FTC's 1999 study.

Interestingly enough, in spite of the latter's limitations, the European Commission's DG Comp published in 2005 a very similar divestiture study[33] to evaluate ex-post the design and implementation of remedies. Moreover, based on the same methodology as the FTC's study but on larger data[34], the DG Comp's study showed that the EU divestiture process experienced as many problems as the FTC in drafting appropriate orders, with a rate of success roughly the same as that of the FTC. Overall effectiveness evaluation was possible in 85 of the 96 analyzed remedies, with the following reported outcome: 57% were effective, 24% only partially, 7% not at all, and the result was unclear for 12% of the remedies. All 'ineffective' and all 'partially effective' divestiture remedies suffered from problems related to the inadequate scope of the divested business. Briefly stated, the DG

[32] See the FTC's 2002 "Report to Congressional Requesteres to Assess the Effects of Divestitures in Retail Markets" for a comprehensive list of the (methodological and informational) limitations of the FTC's 1999 remedy study.

[33] Available at www.europa.eu.int/comm/competition/mergers/others/remedies_study.pdf

[34] In total, 96 remedies were retained, representing 74% of all the remedies included in the 40 decisions chosen and 42% of all 227 remedies included in the 91 conditional clearance decisions adopted during the five year reference period from 1996 to 2000. This period was chosen because at the time it contained the most recent set of cases for which the implementation of the remedies could be analysed *ex post* after a reasonable interval, i.e. three years for the most recent cases.

Comp's 2005 study equally found that the divestitures were most likely to work if the sale of a "stand alone" business was required, and that without this provision, it was frequently necessary to also order technical assistance to establish the buyer as a viable competitor, because buyers did not always know how to operate the business they were buying. It should be recalled though that all selected cases were decided before the publication of the Commission's 2001 Remedies Notice and 2003 Best Practice Guidelines, so the study can be interpreted as justifying ex-post the necessity of these policy statements.

Given the similarity of results and methodology, but also the time span separating the actual policies analyzed by these two qualitative studies on merger remedies, one cannot but wish to check their findings against the quantitative evidence.

The point is that there is no systematic econometric evidence on the question of whether ordered remedies achieve what they are supposed to achieve, namely to assure that proposed mergers do not lead to an increase in the firms' market power.

For the European merger control such an econometric study has only recently become available. Duso et al. (2006) looks at the effects of remedies in a sample of 167 mergers reviewed by the European Commission between 1990 and 2002. Based on an event study methodology, the paper finds that remedies were not always appropriately imposed, i.e. sometimes remedies were unduly imposed in mergers that were found to be efficiency increasing (type I errors), while some other times remedies were not imposed in mergers identified as increasing market power (type II errors). This latter result unfortunately appears to be robust both to the time period and the policy specifications. Elzinga (1969), quoted by Duso et al. (2006) as possibly the first (and for long the only other) econometric study trying to evaluate the *ex post* effectiveness of ordered remedies in challenged merger cases, analyzed the effectiveness of remedies in the 50s under the antimerger statute contained in Section 7 of the Clayton Act. Using a random sample of 39 antimerger cases, the paper rated remedies using a four category ranking system: successful, sufficient, deficient, or unsuccessful. The results suggest that only one out of ten cases could be classified as successful or sufficient. Since the days of this study, the HSR Act was passed, but no ex-post econometric analysis is currently available on the effectiveness of the US remedy policies.

All in all, "it is remarkable that there are so few empirical studies on the effects of merger control and of merger remedies. Competition authorities have been very reluctant to engage in systematic reviews of their merger decisions a few years after they have been taken. Yet such systematic reviews could shed light both on the relevance of the prospective analysis underlying their decisions and on the appropriateness of the merger remedies they accepted" (Jenny (2003)).

4.4.2 The economics of merger remedies

The previous evidence section basically highlights the lack of a minimal quality control of merger regulation mechanisms. This seems to be all the more necessary that the policy of remedies appears to be the outcome rather than the starting point of the every-day practice or merger remedies, with the various remedy guidelines and notices resulting from a learning-by-doing process of active remedy application, instead of inspiring it in the first place.

Arguably, designing effective divestiture plans and avoiding the implementation of those that are likely to fail is not an easy task. Still, despite their economic importance, remedies are clearly an under-researched topic as far as their economic effects are concerned. In what follows, we are going to review the contributions to what could be called "the economics of divestitures".

Horizontal mergers not only reduce the number of market participants, but equally change the distribution of assets in the industry, thus modifying market performance through both unilateral and co-ordinated effects. By reshaping the asset allocation among firms, divestitures do much the same. According to the policy, transferring overlapping assets should satisfy the effectiveness requirement of divestitures. Instead, the economic theory suggests that the market outcome of asset transfers can be rather complex.

Based on the widely used Cournot model, Farrell and Shapiro (1990,b) examine the voluntary sale of capital goods by one oligopolist to another, in terms of market price and welfare. Their results comfort the traditional approach of merger policy, because smaller firms are shown to have insufficient incentives to increase the concentration of capital ownership, and they should be encouraged to do so by combining with each other - or,

rather, by taking over divested assets. Actually, with constant marginal costs, basic comparative statics on the quantity competition model obtains that the lowest price obtains for a symmetric firms industry. Thus, in a model with constant marginal costs decreasing and convex in capacity[35], Medvedev (2004,a) exploits this result[36] in order to compute the optimal asset transfer that will satisfy the CA's consumers' surplus standard by inducing a more symmetric capital distribution.

A few remarks are necessary at this point. To start with, Vergé (2006) aims to contradict the optimistic message in terms of there always being an asset transfer to provide competition relief, by claiming in the framework of Farrell and Shapiro (1990,a) that there is no such divestiture for mergers without synergies. Furthermore, it has been convincingly argued that asset transfers may have pro-collusive effects. As Motta et al. (2003) remind, symmetry and multi-market contacts[37] are two factors facilitating collusion, and asset transfers may contribute to both. Vasconcelos (2005,a) examined the impact of asset transfers on the sustainability of tacit collusion with quantity competition, and found that the merger can actually hinder collusion by increasing the industry heterogeneity of asset holdings. Divestitures would reverse this and thus lead to the opposite result. Compte et al. (2002) show that this is a robust conclusion, by obtaining it in a price competition with capacity constraints model, tailored to the high-profile Nestlè/Perrier case[38]. In light of these arguments, Motta et al. (2003) could but recommend that the same double test that the EC uses to assess mergers also apply for structural remedies, namely that both single and joint dominance will not likely arise after divestiture (i.e. check for both unilateral and co-ordinated effects).

To put it differently, the theory reminds that besides the effectiveness requirement and in connection with it, competition agencies should make sure that divestitures do not make things worse. This could be due to several reasons.

[35] Perry and Porter (1985) initially proposed this specification, rather extensively used since in the theoretical Cournot literature.

[36] Basically, it is the underlying idea for the use of the HHI index.

[37] See Bernheim and Whinston (1990).

[38] Accordingly, "the proposed take-over of Perrier by Nestlè with the sale of Volvic to Nestlè was the worst possible solution from the point of view of competition."

To start with, the competition authority itself might be tempted to use the remedy beyond its corrective purpose, in order to "improve" the deal and overall industry performance. Farrell (2003) warns against the outcome of such an 'overfixing' temptation to engage in industrial policy, on account of the negative impact on the firms' incentive to seek and pursue merger opportunities[39]. In a perfect information model of merger control, Vasconcelos (2005,b) explicitly looks at the agency's incentive to implement by means of divestitures its most preferred market structure and the ensuing possible hold-up effect on not yet submitted mergers. In chapter 5 of this dissertation, we address the possibility for overfixing in an asymmetric information framework, and conclude that the agency should refrain from applying remedies together with the efficiency defence if efficiency-driven mergers are to be encouraged.

Along a different but related line, the asymmetric information which is intrinsic to the merger control framework could explain why divestitures can fail or make things worse. Basically, the competition agency has imperfect information both w.r.t. the necessary amount of assets to divest, and the parties' (seller and buyer) incentives to accept and employ the divestiture. More precisely, the asset transfer is supposed to address the merger's net anti-competitive effect, but for that the agency should be able to assess the merger's potential efficiency gains. Parties have privileged information on this, hence Rey's (2000) intuition that "the competition authority could try to screen merger proposals using transfers or quasi-transfers in the form of concessions...". First Gonzalez (2003) proposed a revelation mechanism based on divestitures as a screening device. His menu of contracts also contains the choice of the market where the divestiture will take place. In chapter 6 of this dissertation we propose an alternative, which allows remedies to be effective on the same market as the originating competitive damage. Our screening mechanism enables information revelation by using divestitures and their sale price as screening devices within a menu of contracts.

In a different context, Farrell (2003) suggested that the sale price of divested assets

[39] The article also reminds that 'overfixing' can equally be due to the overlapping of antitrust or geographic jurisdictions - see Bensaid et al. (1995) for a model of the former case and Neven and Röller (2000) for a discussion of the latter.

can convey private information on the interests and incentives of the industry firms. Commenting on the results of the 1999 FTC's remedies study, Farrell (2003) remarked that instead of directly putting down the remedy failure to the buyer's lack of information, expertise or bargaining power in securing a successful divestiture package, it might make more sense to acknowledge instead that the buyer's interest is simply opposed to that of the agency. It is enough to consider a very simple Cournot setting to see this. Basically, an anticompetitive horizontal merger gives the merged firm an incentive to reduce output, so as to benefit from a market price increase. The final outcome is the same if, instead of shutting down some production sites, these are transferred to an outsider firm which is not capacity-constrained, so it will not react by expanding output as the agency might hope for. Farrell (2003) actually points out that more generally, the purchaser of divested assets lacks incentives to act in a competition-friendly way upon the asset transfer (neither securing a package that truly preserves competition, nor demanding key assets enabling keen rivalry), because this would "shrink the financial pie to be divided between the buyer and the insiders". In short, both seller and buyer have a common interest in limiting their competition. However, the traditional view taken only focuses on the 'anti-competitive' incentives of merging firms to make sure that the purchaser will not turn into a tough rival[40].

Nevertheless, besides the information asymmetry and the opposing incentives, the outcome of the divestiture could be different from what the agency requires for still different reasons. Even if the divestiture is the necessary condition for the merger to be cleared, merging firms may agree to divest for other reasons as well.

Firstly, assuming a "free entry" equilibrium both before and after the merger in a spatially differentiated oligopoly, Cabral (2003) shows that by selling assets (stores) to potential rivals (new entrants), merging firms "buy them off", in other words, dissuade them

[40] The competition authorities are aware of this side of the incentive problem, because it triggered safeguards like the 'hold-separate' procedure and appointment of divestiture trustees to ensure that the seller does not diminish the value of the assest pending the sale. With this respect, Motta et al. (2003) quote the example retained by Parker and Balto (2000) where the seller was eventually sued and fined for having decreased on purpose the value of the divestiture package, but overall this was still more profitable for him than putting up with a strong new entrant.

from opening new stores, which may be detrimental to consumers through higher prices and search costs. The crucial assumption is the "free-entry" assumption, which highlights the importance of assessing the counterfactual to the remedy decision, i.e. would entry occur in the absence of imposing (structural) remedies or not. Secondly, in a model of endogenous mergers, Fridolfsson and Stennek (2005,a) examine the hold-up effect due to the outsiders' free-riding on the industry externality generated by an anti-competitive merger. The paper argues that when designing the merger policy, this obstacle to market monopolization should be taken into account, precisely because the divestiture requirements that apply to such anti-competitive mergers actually diminish the hold-up effect. The intuition is straightforward: the divestiture, through its sale price, introduces a channel for transferring wealth between the buying outsider and the merging firms, the latter extracting the buyer's willingness to pay for the externality generated by their merger. In other words, by requiring a divestiture, the agency possibly lowers the hold-up effect and encourages the firms to merge[41], so divestitures should not be taken for granted to represent a cost for the merging firms. Finally, as suggested by Seldeschlachts et al. (2006), the systematic use of remedy decisions is reckoned a signal of a 'soft' merger policy, in which the agency appears very keen to clear mergers if at all possible. According to Neven et al. (1993, p.7) "lawyers in particular are aware that this may give them significant bargaining power with the (European) Commission even in doubtful cases". This clearly goes against the original expectation about the possibility of a remedial action - according to Baer and Redcay (2003), the requirement to file a pre-merger notification and wait pending the agency's review was reckoned to increase the negotiation power of the agency, because an eventual litigation over the remedy involved supplementary delay, so firms were expected to become more inclined to accept the settlement terms requested by the agency.

4.5 Concluding remarks

If anything, more insight from economic theory is needed to seize the full implications of the in-depth change brought to the market by the application of remedies, for in many

[41] Chapter 3 in this dissertation equally obtains this, in the case of an asset sale to a new entrant.

academic contributions merger remedies are only incidentally looked at. We feel the same holds for the very assessment of the merger's efficiencies. The following two chapters of this dissertation hopefully contribute to a consistent economic analysis of merger control, by directly addressing both merger remedies and the efficiencies' assessment.

First, to study the interaction between them as well as the opportunity of applying together an efficiency defence and remedies, Chapter 5 presents an original model issued from joint work with Jean-Philippe Tropéano. Basically, we provide an answer to what should be the best merger policy, considering the relative importance of the two types of merger control errors. Within the asymmetric information relationship between the regulating agency and the merging firms, we find that if the benefit expected from an efficient merger is high, the best policy consists in applying an efficiency defence without allowing remedies. Instead, should an inefficient merger cleared without remedies be extremely harmful, then the combination of remedies and efficiency defence is the most appropriate for maximizing expected welfare.

In Chapter 6, equally issued from joint work with Jean-Philippe Tropéano, we take up the intuition that merger remedies can be used as a screening device to extract the insiders' private information on the merger's efficiencies. We propose a revelation mechanism combining in a menu of contracts the amount of divested assets and their sale price. These instruments allow effective revelation with minimal distortion by reconciling the diverging interests of the three parties involved in the divestiture negotiation, the competition authority, the insiders and the buyer of divested assets.

Chapter 5

Impact of Remedies on the Efficiency Defence and Consequences for Merger Control

To remedy or not to remedy, that is the question...

This chapter builds on joint work with Jean-Philippe Tropéano, available as Worknig Paper "On the Effective Design of the Efficiency Defence", Cahiers de la MSE n° 2006-30.

5.1 Introduction

Merger control aims to screen concentrations, so as to identify and clear competitive mergers, as well as prohibit or modify and thus make less harmful the anti-competitive ones. Central to the merger assessment process are the potential efficiency gains that the merger may generate, because they determine the net final effect of the concentration, and hence its (anti)competitive status from the merger control point of view. Merger regulations acknowledge that in order to improve the outcome and performance of the merger control, efficiencies need to be taken into account[1]. The theoretical rationale can be traced back Williamson (1968), who developed the concept of a trade-off analysis between losses in allocative efficiency and gains in productive efficiency as a result of a merger. In all likelihood, this should prevent the prohibitions of efficient mergers, although merger control is feared to become thus too lenient, on account of the privileged information that firms have w.r.t. the motivations and competitive potential of their merger.

To prevent this, competition authorities make use of remedies, which have become (unlike prohibitions) the preferred reply to the issue of how best eliminate the competition concern of a merger. Remedies are (structural or behavioural) 'commitments' offered by the merging parties in order to secure the merger approval. The object of remedies is to reduce the parties' market power and restore conditions for effective competition, lest the merger be detrimental.

The key point is that, unlike other branches of antitrust, dealing with the ex-post punitive control of illegal conduct, merger control is supposed to assess the merger's consequences, and to remedy them if necessary, before they even take place (Motta (2004)). By definition therefore, due to the intrinsic uncertainty of this ex-ante evaluation, merger control is always prone to type I and II errors. The true challenge for the merger policy is then to minimize the consequences of the two types of errors, which is not necessarily

[1] According to the EC Merger Regulation (as revised in 2004): "In order to determine the impact of a concentration on competition in the common market, it is appropriate to take account of any substantiated and likely efficiencies put forward by the undertakings concerned" - see the Council Regulation (EC) No 139/2004 of 20 January 2004 on the control of concentrations between undertakings, Official Journal, L 24, 9/01/2004, p.1-22.

focusing on a lower number of errors, but rather minimizing type II errors in those cases where significant net harmful effects are likely, and minimizing type I errors in those cases where significant net beneficial effects are likely.

To examine such optimal merger control, in this chapter we are going to follow the 'more subtle economic view' advocated by Farrell (2003) and take the stand to account for the *ex ante* incentives of merger control.

5.1.1 Purpose and relevance

One consequence from taking into account efficiencies for merger assessment is that merging firms can bring forward the potential efficiency gains from merger as an argument to increase the probability of merger acceptance, within the so called 'efficiency defence'. We claim here that the latter can provide positive ex-ante incentives, and thereby reduce the cost of type I errors by encouraging the submission of more efficient mergers. Intuitively, if firms cannot benefit from their commitment to achieve these efficiency gains, they have lower incentives to make the effort of achieving them, because in practice, planning and achieving an efficient merger is costly:

> "As a recent Financial Times article ("Clean teams banish acquisition uncertainty", August 8, 2006) argues, an increasingly favoured approach to integrating two disparate companies is "to use a 'clean team', a group isolated from the operational management of both companies, usually consisting of 10 or 20 people drawn from inside and outside the companies. Clean teams collect and analyze data from both parties, which it then uses **to plan how the merger will work** - and crucially, where the synergies and cost savings will occur. Such a team starts it work well in advance of the completed deal, setting out a strategy for realizing the claimed 'synergies'."[2]

[2] Further quoting Oligopoly Watch (August 12, 2006), "Such teams were used in the initial combination of three firms that formed Arcelor in 2001. It was used by Hewlett-Packard in its acquisition of Compaq in 2002. Cadbury Schweppes followed suit in its buyout of Adams Gum in 2003 from Pfizer. Because of the big expense, the approach is mainly used by big firms for big (billion dollar plus) deals."

The point we wish to make is twofold: besides arguing in favour of potential efficiencies being taken into account in merger control, (incidentally, without involving the information-related evidence production costs à la Lagerlöf and Heidhues (2005)), we add that at least as relevant is rather how this is to be done, considering the asymmetric information and the available remedial instruments of the competition authority.

Concerning merger remedies, conventional wisdom indicates that they enlarge the set of acceptable mergers (obviously, as compared with the application of downright prohibitions). In terms of their *ex ante* incentives, Seldeslachts et al. (2006) for instance argue that they remove the deterrence effect of the merger policy, since firms no longer avoid proposing anticompetitive mergers, feeling confident that at worst, it will take a remedy to get the merger approved. Instead, Farrel (2003) claims that remedies "may confiscate the private rents from seeking out and pursuing efficiently-oriented mergers".

Taking on this idea, *we are going to examine how the use of remedies affects the ex ante effect of the efficiency defence, as well as the informational problem that the competition authority faces w.r.t. the latter, so as to conclude on the opportunity to apply both remedies and the efficiency defence within an optimal merger control.*

5.1.2 Outline of model and results

The starting point of our model is the informational problem to which the assessment of efficiencies is subject. To start with, they can only materialize after the merger is completed and are therefore merely potential at the time of the review. Actually, we assume here that the efficiency gains can only result from an *ex ante* designing effort undertaken by the merging firms. This effort is costly and it does not always succeed, and the insiders are privately informed on the result of this *ex ante* planning effort. To account for this information problem, in our framework we interpret the efficiency defence (ED from now on) as a commitment on behalf of the competition authority (CA henceforth) to take into account for the merger clearance decision some signal, which is only imperfectly correlated with the merger's efficiency gains. As a result, the two types of error are possible, because a good signal can make the CA accept an inefficient merger, whereas a poor signal can induce the refusal of an efficient merger. We call an ED decision rule this

commitment of the CA to clear mergers based on the above-mentioned signal.

A possible alternative for merger clearance, and the one we consider here, is for the CA to accept the merger only if firms adopt remedies. We model them in accordance with the current policy, as commitments undertaken by firms, which imply a private cost for them, to the extent that the profit thus obtained is lower than it would be without remedy. Furthermore, a remedy will be effective, and thus ensure a welfare improvement w.r.t. the status-quo if applied to a anti-competitive merger, yet it will write off any private benefit from efficiencies if undertaken by efficient firms. The approval of mergers depending on the submission of a remedy proposal will constitute an alternative decision rule for the CA.

In this framework, the first objective is to determine the opportunity for the CA to adopt the ED decision rule for merger clearance, rather than the remedy rule. We show that the CA adopts the ED rule only if the quality of the signal is high enough. The intuition is the following: applying the ED rule is justified as long as firms exert the costly effort and there are sufficiently rare errors of both types, so as to obtain in the end a higher expected welfare than with remedies only. Insiders will undertake the effort only if the probability to see the efficient merger accepted is high enough. Similarly, from the CA's standpoint, the expected welfare with the ED is higher than the welfare with remedies if the probability to accept an inefficient merger is low enough. All in all, the application of the ED is justified for the CA basically as long as the welfare loss due to both types of error is not too important. It should be noted that the adoption of the ED rule stems from the trade-off between the following two effects. On the one hand, the benefit from the ED is the provision of the incentive effect, making firms exert the costly effort to obtain efficiencies, but on the other hand, the cost of the ED is the risk of type II error and the ensuing welfare loss due to the imperfect signal.

The next step is to study the opportunity for the CA to adopt a decision rule that allows both remedies and ED, meaning the commitment to clear a merger either if the signal observed is positive or if firms undertake remedies. We show that when thus allowed for together with the ED, merger remedies affect the previously mentioned trade-off between the incentive and type II error effects. On the one hand, for a substantial range of quality

of merger assessment, the remedies lower the *ex ante* effort incentives of firms, because they increase the opportunity cost of the ED for the merging firms - the latter can always propose remedy instead, and have their merger cleared. On the other hand, accepting a merger with remedy represents for the CA the opportunity of completely eliminating the type II error. More precisely, when given the choice between applying for the ED and proposing remedy, firms may actually self-select, depending on the error probability of the merger assessment. Indeed, the higher the quality of the merger assessment (of the signal, basically), the higher the cost to notify an inefficient merger without remedies. Thus, an inefficient merger is induced to propose remedies and it is possible that firms truthfully signal the characteristics of their merger through the notification ultimately made, thus eliminating the information asymmetry.

This allows us to conclude that if the welfare cost of accepting an inefficient merger is quite high, the CA prefers to allow remedies in addition to the ED rather than an ED decision rule without remedies, so as to make firms self-select according to their level of efficiencies. In turn, if the CA can instead afford to privilege the effort incentive provision, because the welfare loss of an inefficient merger is not too prohibitive, then it will rather apply the ED without allowing remedies. *Basically, we provide an answer to what should be the best merger policy, considering the relative importance of the two types of merger control errors. We argue that if the benefit expected from an efficient merger is high, the best policy consists in applying an ED without allowing remedies. Instead, if an inefficient merger without remedies is highly harmful, the combination of remedies and ED is more appropriate for maximizing expected welfare.*

5.1.3 Related literature

The true novelty of our study is to examine the interaction between remedies and ED, which together shape nowadays most merger regulations. To our knowledge no work has been done on this topic, and this chapter contributes to filling the gap[3].

[3]Incidentally, part of our results are close to those obtained by Häckner and Razo (2004) for congested markets, according to which the competition authority would better refrain from divestitures if it aims at efficiencies and consumer surplus gains. Instead, we argue this intuition based on the ex ante respective

However, the *ex ante* effects of the merger policy in general have already been pointed out in the literature. Neven et al. (1993) note that merger control may result in "mergers that would otherwise be attractive to firms, but that they do not even try to undertake because of fear that they will not be approved [...] or in transactions that may take place in a form different from that they would have taken in the absence of regulation", which Aaronson (1992) sums up as a frequency-based deterrence effect (merger plans being forsaken) and a composition-based deterrence effect (mergers being shaped differently). Seldeslachts et al (2006) briefly review the literature suggesting that the merger policy instruments do have *ex ante* effects on firms' merging projects, before testing for the deterrence effects of these instruments. Persson (2004) criticizes the tendency to enforce a stricter merger policy, as he claims it may turn out to be counterproductive, because it can increase the incentive for predation[4]. In his turn, Ecer (2005) shows that the tendency to apply a stricter merger policy may be instead ineffective, since firms endowed with rational expectations are able to bypass it. Basically, he argues that it does make sense to assume that merging firms react to the existing merger control provisions by designing merger projects accordingly, much in the vein of Besanko and Spulber (1993): "the size and type of firms that contemplate mergers are determined not only by the anticipated returns from the merger but also by antitrust merger enforcement"[5].

Thus, the first point we make, concerning the positive *ex ante* effect of the ED on firms' incentives to undertake more efficient mergers, is quite recurrent actually. The

incentives of the efficiency defence and merger remedies.

[4] In the field of patent law and innovation policy, Caillaud and Duchene (2004) similarly argue that a stricter regulation is not optimal. The article addresses the overload problem faced by the US patent office, and obtains that the optimal patent assessment process should be rather lenient and accept a number of "bad" patents within a pooling equilibrium, because this encourages the up-stream R&D, so that more "good" patents would eventually be granted.

[5] See also Barros (2003) for a study of the change in the design of cooperative agreements induced by the shift from an *ex ante* notification regime to one of *ex post* control under the European Commission reform of the Communitary competition policy. Accordingly, the ex-post control of agreements is shown to induce the self-selection of more competitive projects, since partners face a higher opportunity cost than in the case of the *ex ante* notification regime. See also Bergès-Sennou et al. (2004) on the same topic, but from an opposite standpoint (i.e. identifying the optimal strategy in terms of competition policy).

intuition is simple: industry firms have lower incentives to seek for more competitive deals if the competition authority does not take into account their effort to do so. According to Jorde and Teece (1990) (see also Shapiro and Willig (1990)), the fact that in the 80s the joint ventures were cleared in Europe after a global economic evaluation under the 85(3) article was considered to give higher incentives for firms engaging in innovating cooperative agreements. Typically, the argument of the parties in favour of their cooperation was the prior costly investment undertaken to smooth technological transfer and to enhance the complementarities between partners, and in the US it was feared that the stricter antitrust control applied there deterred American joint ventures contemplating innovation. Actually, the modelling intuition that we retain from these papers is their example of the *ex ante* effort argued by the joint venture partners - we build on it for modelling the endogenous efficiency gains (see also Fabrizi and Lippert (2004) and Cabolis et al. (2005) for models of endogenous efficiency gains obtained through mergers).

By the same token, the *ex ante* incentive properties of merger remedies have also been more or less pointed out. Antitrust authorities have long now shown a keen tendency to employ remedies to alleviate the anti-competitive effect of proposed mergers instead of engaging in preventions, which makes the use of remedies appear as a signal of a "soft" merger policy[6] (see Seldeslachts et al. (2006) for a recent test and confirmation of this hypothesis). To a certain extent, we recall here a negative effect of such 'soft' merger control, where remedies may encourage firms to untruthfully claim efficiency gains by softening the threat of blocking the merger. On the other hand, along with Farrell (2003) and Vasconcelos (2005,b), we also quote the negative effect of remedies of lowering the incentives to look for (and eventually submit) a more efficient merger. Vasconcelos (2005,b) obtains this in a model where the competition authority makes use of divestitures to implement its most preferred market structure (i.e. "overfix" the merger, by going beyond the corrective purpose of the remedy), and thereby may actually discourage firms

[6] For instance, the European Commission (EC) has of late solely relied on structural and behavioral remedies by blocking only one merger since 2001 (the ENI/EDP/GDP case in 2004). In the US, remedies constituted only twenty-three percent of US merger policy actions in the late 1980s, but by the year 2000, remedies were employed in over sixty percent of US merger cases requiring antitrust action (see Parker and Balto (2000)).

to undertake more efficient mergers.

Finally, what distinguishes our contribution from others dealing with the ED as an information process - besides the fact that we consider a merger control framework allowing for *both* remedies and ED - is that we do not focus on the implications of the information-related evidence production costs associated with the information asymmetry between merging firms and the CA. The ED is known to give rise to exacting information requirements, and Gonzalez (2004) examines the optimal information disclosing about efficiency gains from interested parties (merging firms and competitors) to find that the insiders should take on the burden of proof for efficiencies. Such burden of proof necessarily yields a substantial increase in administrative costs for merger control, and the discussion of its implications is important for the economic analysis of the ED. Not surprisingly, the explicit acknowledgement of the ED in the ECMR was actually long debated because of its associated implementation costs (see Ilzkovitz and Meiklejohn (2001) for a review). An important argument against the ED was the possibly prohibitive cost of information acquisition due to the context of asymmetric information for the CA, because without perfect information, the ED procedure necessarily raises the question of the costly verification of those alleged efficiency gains. Lagerlöf and Heidhues (2005) explicitly address this issue, and conclude on the conditions necessary for the cost trade-off to warrant an ED. They obtain that an ED is not worth while if it is too costly for society as a whole, through the evidence production costs it entails on behalf of the merging firms. Still, this result does not take into account the possibility for merging firms to manipulate information or cheat. Medvedev (2004,b) considers this to explain the opportunity of a fuzzy approval rule (i.e. approval probabilities between zero and one), by means of a signalling game where the CA clears mergers with some positive probability, based on its observation of both the evidence supporting the efficiencies claims, and the costly effort to produce it.

The remainder of the chapter is organized as follows. Next we present the model, then we establish a benchmark for our ED analysis, so as to go on then to explore the interaction between ED and remedies. Last, we discuss the implications for merger control. We conclude before presenting all technical proofs in a final section.

5.2 A simple model of merger control with efficiency defence

Consider the following simple model of merger control between the CA on the one hand and the merging firms (called insiders) on the other, the latter proposing to merge on an oligopolistic market. We do not explicitly model the type of competition, because our results simply do not depend on it. As a matter of fact, for the purpose of our model, all that is important is that the merger has a twofold effect: it will involve both a market power increase and some potential efficiency gains (EG henceforth).

The latter can be either high or low, denoted $\overline{e} > \underline{e}$. The low EG are associated with a merger for market power. In turn, to achieve the high EG, insiders need to undertake an *ex ante* effort, requiring a sunk cost F. This costly conception effort to design beforehand their association in a more efficient manner yields an uncertain outcome for the insiders: $\Pr(\overline{e}/\text{effort}) = q \in (0,1]$, $\Pr(\overline{e}/\text{no effort}) = 0$. If the effort fails or is not made at all, firms are left with the low EG $\underline{e}$. Basically, this means that integrating two firms in the most effective and pro-competitive manner requires to spend costly resources designing the merger project, and if the effort fails, this may drain all the supposed benefits of the deal.

We assume that whatever the level of these EG, insiders find it always profitable to merge (thanks to the market power increase, basically). However, the joint profit increases with the level of merger efficiency. In other words, $\Pi(\overline{e}) \geq \Pi(\underline{e}) \geq \Pi_i$, where we denote by Π_i the insiders' overall profit before merger.

To materialize their merger, insiders need the approval of the CA, which maximizes "welfare" W, standing for either Consumers' Surplus or Total Welfare - our qualitative results are not sensitive to the explicit definition of the CA's objective function[7]. All that matters is that from the CA's point of view the two possible merger types have opposite welfare effects: $W(\overline{e}) > W_i > W(\underline{e})$, where W_i denotes the initial, status-quo, level of welfare. In other words, allowing a merger only increases welfare if the insiders did succeed in their designing effort, otherwise the CA would fare better by rejecting the

[7] The choice of welfare standard is irrelevant for our results, because our analysis is based on the impact of remedy application on the adoption threshold for the ED. The precise level of this threshold does depend on the welfare standard retained, but the mechanism behind the above-mentioned impact does not.

merger.

We consider an asymmetric information framework for merger control, and assume that the outcome of the effort is private information of insiders. The CA only observes an exogenous signal s, imperfectly correlated with the merger efficiency gains. s stands for all the relevant hard information that the CA can use to make its decision, which is typically obtained during the merger review process. In practice, the CA gathers information from various sources, its own expertise, the insiders themselves, the outsiders, even consumers. This information comes at a cost, it is certainly not exogenous [8], and parties are able to manipulate it. Yet, for the purpose and outcome of our analysis, only the quality of this information is relevant. Therefore we summarize all this data in an exogenous costless signal (although in practice the CA does spend money and time to evaluate the merger), to better highlight our choice not to focus on the evidence-production cost analysis. For simplicity, denote the signal $s \in \{\underline{s}, \overline{s}\}$, with $\Pr(\overline{s}/\overline{e}) = \Pr(\underline{s}/\underline{e}) = \sigma \in \left[\frac{1}{2}, 1\right]$. Based on this imperfect signal, the CA may very well reject efficient mergers, or, on the contrary, accept mergers that lower the welfare, hence the possibility for both type I and II errors.

However, the outcome of this imperfect merger control may improve if a second instrument is used. More precisely, the possibility to clear an inefficient merger is reduced if, when submitting their merger, the insiders equally propose an effective remedy. Merger remedies are corrective measures under the shape of commitments of merging partners, meant to prevent the negative market-power effect of the merger, and typically involve a private cost for the insiders. We model the remedy as such, and consequently assume that $\Pi(e) \geq \Pi^R(e), e \in \{\underline{e}; \overline{e}\}$, where $\Pi^R(e)$ denotes the profit that insiders obtain when their merger is subject to remedy. Still, despite this cost, efficient insiders would make a higher profit than inefficient ones, $\Pi^R(\overline{e}) \geq \Pi^R(\underline{e})$, if it had not been for the private cost of effort and its uncertain outcome: $\Pi^R(\overline{e}) - \Pi^R(\underline{e}) < \frac{F}{q}$. In other words, we assume that the remedy removes any incentive to exert effort - otherwise, making effort would always be a dominant strategy, and there would be no incentive trade-off to discuss. Finally, as far as the CA's objective is concerned, we assume the remedy to be effective, meaning that when applied for an inefficient merger, it will improve welfare: $W^R(\underline{e}) \geq W_i$.

[8] See Lagerlöff and Heidhues (2005) for a model based on endogenous and costly signals.

The timing of events is the following:

At the first stage, the CA chooses a decision rule for merger clearance, and credibly commits to it by making it public under the form of merger guidelines, which become binding from that moment on. We detail below the decision rules we consider.

At the second stage, insiders make their effort decision and privately observe its outcome.

At the third stage, insiders submit a merger proposal to the CA. Their merger submission may contain remedies, in accordance with the first stage merger policy provisions (i.e. provided the decision rule retained allows for remedy).

At the fourth stage, the exogenous signal on efficiencies is generated and publicly observed. The merger is then cleared or blocked, according to the decision rule chosen at the first stage.

The decision rules basically specify under which terms the ED and the remedies apply. Allowing an ED will be interpreted here as a decision rule for merger approval which takes into account the exogenous signal received on the mergers' efficiency gains. By the same token, allowing remedies comes down to applying a decision rule according to which a merger is accepted provided it has proposed remedy. More precisely, at the first stage of the game, the CA makes its choice between the following three decision rules:

- a "remedy" decision rule, meaning "allow any merger iff it has proposed remedy"

- a "strict ED" decision rule: "allow a merger iff the signal $\overline{s}$ is observed"

- a "flexible ED" decision rule: "allow the merger if the signal $\overline{s}$ is observed or if it has proposed remedy".

By assumption, whenever a merger is rejected, under either decision rule, the status-quo is maintained. Based on these decision rules, we will be able to assess the consequences of allowing remedy together with the ED. In other words, we begin by examining the opportunity to allow the strict ED, then go on to check for the opportunity to allow the flexible ED. Note that the difference between the two ED decision rules consists of the possibility for firms to propose or not remedy when submitting their merger. In other words, by examining the opportunity to allow one or another of the ED decision rules, we will be able to conclude actually on the opportunity for the CA to commit to allowing

remedy or not when applying an ED[9].

5.2.1 The efficiency defence as an incentive device

We consider here a "benchmark" situation, where only the strict ED and the remedy decision rule are available, but mutually exclusive. In other words, if the ED is adopted, the remedy decision rule no longer applies, so merging firms cannot propose remedy when submitting their merger. Equivalently, they do not have the possibility of choosing between attempting the ED and proposing remedy, only the first possibility being available whenever the CA allows it. The benchmark situation thus defined is helpful to determine the opportunity to allow for the strict ED.

Basically, the CA decides whether to allow or not the ED based on the expected welfare, therefore the choice will depend on the quality of available information. The following proposition deals with the opportunity of allowing the strict ED:

Proposition 5.1

The (strict) ED decision rule is chosen only for a sufficient quality of information: there exists $\widetilde{\sigma}$ *such that for* $\sigma \geq \widetilde{\sigma}$ *the CA applies it.*

See proof at the end of the chapter.

Basically, the ED is chosen only for a sufficient quality of information. This is so because two conditions need to be fulfilled in order for the application of the ED to be preferred to that of remedies, both requiring a sufficient quality of merger assessment. On the one hand, firms would be led to exert effort under this decision rule, and on the other hand, the resulting expected welfare should be higher than without the ED.

The former condition will yield a certain threshold in terms of signal quality, because firms' incentives to exert effort under the ED decision rule depend on the quality of the subsequent merger assessment (basically, a private rationality condition). Explicitly, if the signal is very poor, so that the EG are rarely recognized as such, then the effort is not

[9] Note this is much in the spirit of Lagerlöf and Heidhues (2005), who check for the opportunity to apply an ED. We will be able to examine the opportunity of allowing remedy together with the ED, in addition to establishing when the ED itself is desirable.

worth while, since it is costly and its outcome uncertain. We denote by σ^* this threshold above which the firms are induced to exert effort with the strict ED rule. From the CA's point of view, firms having exerted effort is a necessary, but not sufficient condition to allow the ED. Indeed, even if the insiders did succeed their costly effort, the expected welfare may still be inferior to that obtained without the ED, precisely if the quality of information is too poor to ensure an accurate assessment of the EG, i.e. if the welfare loss due to both type I and II errors is too important. These are unjustified approvals (type II error, "false positive") and unjustified prohibitions (type I-error, "false negative"), and in both cases the potentially achievable level of economic welfare is not attained. Thus this second condition equally yields a threshold in terms of signal quality, such that the welfare improves above this threshold. Proposition 5.1 fixes the relevant information quality threshold $\widetilde{\sigma}$ to be the maximum between the two critical levels thus identified, so as to make sure that both conditions are fulfilled.

Note that the relevant threshold for the strict ED adoption depends directly on the magnitude of the welfare levels corresponding to the two types, $W(\overline{e})$ and $W(\underline{e})$ respectively. More precisely, the lower the welfare loss $W(\underline{e})$, the higher the cost of type II error and therefore the higher the threshold $\widetilde{\sigma}$. By the same token, the higher the welfare gain $W(\overline{e})$, the higher the opportunity cost of not allowing the ED, so the lower $\widetilde{\sigma}$.

Proposition 5.1 emphasizes that the higher the quality of information, the more likely is the ED rule, meaning that the latter can be optimal despite the imperfect information and the ensuing possibility to accept some inefficient mergers. Note however that even for extremely precise signals, which guarantee both effort exertion and a higher expected welfare than with remedy, the ED decision rule always leaves open the possibility of a welfare loss. Instead, the remedy decision rule also guarantees a welfare improvement, although potentially lower than the ED since it does not provide effort incentives, but prevents any type II errors. This basically highlights the trade-off for the CA's choice to apply the ED decision rule, between what we call an "incentive effect" and a "type II error effect". On the one hand, by allowing the ED, the CA gives firms incentives to exert effort and thereby to propose an efficient merger. This basically lowers the final cost of type I errors, given the imperfect merger assessment, and represents the "incentive" effect of the

ED. On the other hand, by not allowing the ED and instead applying the remedy decision rule, the CA prevents any type II error. This is the "type II error" effect.

Keeping this in mind, the question we ask next concerns the way in which this basic trade-off is affected if remedies are allowed in addition to the ED rule, and the likely consequences in terms of incentive and type II error effect.

5.2.2 Merger control with remedies and efficiency defence

We begin by determining when the choice of the flexible ED decision rule is made rather than the application of the remedy one. This comes down to finding when the CA chooses whether to apply or an ED, knowing that in both cases the remedy is another possibility to clear the merger. In other words, by examining the opportunity of the flexible ED, we can assess the impact of remedy on the way the available information is exploited.

A backwards induction through the game is necessary, but since the last stage of the game contains no strategic move, we begin our analysis at the merger notification stage. At this stage, the essential change with respect to the benchmark situation is that the ED and the remedy are no longer mutually exclusive. Since a merger is cleared either if the signal $\overline{s}$ is observed, or if a remedy is proposed, insiders are basically given the opportunity to choose their merger notification: it may either contain a remedy, thus guaranteeing its acceptance, or it may not contain a remedy, in which case they run the risk of rejection.

The following result gives the impact on the outcome of the submission subgame of the possibility to propose remedy:

Lemma 5.1

There exists two signal quality thresholds, $\underline{\sigma}$ and $\overline{\sigma}$, $\underline{\sigma} < \overline{\sigma}$, such that the outcome of the submission subgame is as follows:

(i) for low quality signals, $\sigma < \underline{\sigma}$, only efficient insiders ($\overline{e}$-mergers) propose to undertake remedy;

(ii) for medium quality signals, $\underline{\sigma} < \sigma < \overline{\sigma}$, either all mergers are submitted with remedy, or none;

(iii) for high quality signals, $\sigma > \overline{\sigma}$, only inefficient insiders ($\underline{e}$-mergers) propose to

undertake remedy.

See proof at the end of the chapter.

We find that allowing the flexible ED gives insiders the opportunity to self-select by means of the merger notification they make. This outcome of possible self-selection depends on the probability of assessment error, or, equivalently, on the quality of available information. More precisely, for very poor signals such that the probability for EG to be recognized as such is very low, insiders which did obtain these EG do not run the risk of rejection with the ED, but propose instead remedy with their merger to ensure its approval. In turn, for very good signals, such that the probability of detecting an inefficient merger is very high, inefficient insiders will not run the risk of an ED and prefer to propose remedy. Finally, for intermediate signal qualities, both efficient and inefficient insiders choose the same type of notification, either with remedy or without, so no self-selection occurs, as in the benchmark situation.

The intuition behind this result is simple. For very good signals, the probability of detecting an inefficient merger is very high, thus inefficient insiders prefer to propose remedy whereas efficient ones propose the merger without remedy. Yet, if the information quality is lower, the opportunity cost of an inefficient firm to propose a merger with remedy increases, because there are less chances for it to be rejected if it attempts the ED. Thus, a lower signal quality gives incentives to inefficient insiders to propose a merger without remedy. As far as the efficient insiders are concerned, the opposite occurs. If the information quality is poor, the probability for a merger without remedy to be rejected is high, so the opportunity cost to argue the ED, without remedy, increases. In short, for low quality signals the efficient insiders prefer to submit a merger with remedy.

At this point, it is worth pointing out that besides their corrective role, remedies can possibly convey information on the level of merger efficiency gains. As a matter of fact, by being given and making the choice to propose or not remedy, merger partners may signal the type of their merger. Thus, for $\sigma > \overline{\sigma}$, the choice to propose or not remedy allows the efficient insiders to signal themselves out and to self-select.

At the previous stage, when choosing the type of the merger by deciding to make effort or not, insiders anticipate the outcome of the notification subgame. Since the possibility

to propose remedy gives the opportunity to self-select for certain signal quality ranges, it implicitly affects the firms' expected payoff from making effort over these intervals. Therefore, as compared with the benchmark case, we can see its impact on the effort incentives provided by the ED. This impact also depends on the quality of available information, and is given by the following:

Lemma 5.2

Define σ_R^* *such that for* $\sigma \geq \sigma_R^*$ *insiders undertake effort under the "flexible" ED; then* $\sigma_R^* \geq \sigma^*$*, where for* $\sigma \geq \sigma^*$ *firms undertake effort under the "strict" ED.*

See proof at the end of the chapter.

As indicated in Proposition 5.1, individual rationality requires firms to make the costly effort only for sufficiently accurate signals, because the assessment of efficiency gains is subject to errors. The possibility of proposing remedy when the CA allows the ED has an impact on the signal quality that is deemed sufficient for effort to be made. With this respect, Lemma 5.2 claims that under the "flexible" ED rule the *ex ante* effort incentives are lower than under the "strict" ED rule[10]. As a result, the information quality requisite is higher than in the benchmark situation.

The result given in Lemma 5.2 is explained by the fact that the remedy basically softens the threat of a merger rejection, and thereby modifies the opportunity cost of the ED. More precisely, from the insiders' point of view, the possibility to propose remedy increases the opportunity cost of notifying a merger with the ED. To make their effort decision, firms take into account the expected payoff, and implicitly therefore the outcome of the relevant alternative. In the benchmark situation, making effort was individually rational as soon as the expected profit (increasing with the signal quality) outweighed the status-quo profit, since proposing remedy was not available for firms under the "strict" ED decision rule, so the relevant alternative was the payoff in case of merger rejection. In turn, when the decision rule takes into account the remedy submission, the effort becomes

[10] This holds actually for sufficiently accurate signals, $\sigma \geq \underline{\sigma}$. We show in the proof that even though the remedy does enhance the effort incentive for the lowest signals, $\sigma < \underline{\sigma}$, this does not alter the firms' ultimate effort decision, which is not to make effort. This is the reason why in the proof of Lemma 5.2 we stress that $\sigma^* > \underline{\sigma}$.

rational provided it yields a higher expected profit than the payoff with remedy. Simply because firms can always choose to propose remedy and thereby avoid the status-quo, the payoff with remedy becomes now the relevant payoff alternative, and this is superior to the status-quo payoff. Insiders might be more easily content with this high alternative payoff, and therefore require a more accurate assessment of EG in order to give it up, and instead run the risk of an uncertain effort to submit afterwards a merger without remedy. As a result, the relevant threshold for effort exertion under the "flexible" ED decision rule is superior to that under the "strict" one. And since the signal quality requisite is higher, the effort incentives are lower.

Thus, from the CA's standpoint, simultaneously allowing for both the ED and remedies leads to two opposing effects. On the one hand, the remedy reduces the *ex ante* effort incentive of the merger policy. On the other, it can provide a means for firms to self-select, and hence it can dramatically improve the outcome of merger control, by removing completely the possibility of a welfare loss, i.e. making a type II error and accepting inefficient mergers - this is actually the case whenever the quality information is above the threshold $\overline{\sigma}$. Therefore, the decision to allow or not simultaneously both remedy and the ED (within the "flexible" ED decision rule) implies for the CA to choose between minimizing type I errors, and completely avoiding type II errors.

We address next the choice of decision rule at the first stage of the game, for which we obtain the following result:

Proposition 5.2

(i) If $\widetilde{\sigma} < Max(\sigma_R^*, \overline{\sigma})$*, then:*

- for $\sigma < \widetilde{\sigma}$*, the CA does not allow an ED and only applies the remedy decision rule;*

- for $\widetilde{\sigma} < \sigma < Max(\sigma_R^*, \overline{\sigma})$*, the CA allows the strict ED ;*

- for $\sigma > Max(\sigma_R^*, \overline{\sigma})$*, the CA allows the flexible ED.*

(ii) If $\widetilde{\sigma} \geq Max(\sigma_R^*, \overline{\sigma})$*, then:*

- for $\sigma < Max(\sigma_R^*, \overline{\sigma})$*, the CA does not allow an ED and only applies the remedy decision rule;*

- for $\sigma > Max(\sigma_R^*, \overline{\sigma})$*, the CA allows the flexible ED.*

Proposition 5.2 gives the optimal decision rule of the CA depending on the quality of information available. This outcome results from the comparison of adoption thresholds for the strict and respectively the flexible ED rules - see the details at the end of the chapter.

Basically, two configurations may arise, depending on the relative position of these two thresholds. The first one corresponds to a rather low welfare cost of the type II error, which explains that the threshold $\widetilde{\sigma}$ for the strict ED adoption is low itself: $\widetilde{\sigma} < Max(\sigma_R^*, \overline{\sigma})$. In such a case, the possibility of remedy in addition to the ED does not affect the opportunity to allow an ED rule, because the information quality threshold above which the CA resorts to an ED remains equal to $\widetilde{\sigma}$. In other words, there is a range of quality signals for which the CA prefers to refrain from allowing remedies together with the ED. Nevertheless, for high information quality ($\sigma > Max(\sigma_R^*, \overline{\sigma})$), the CA turns to the flexible ED rule. The second configuration corresponds to a high cost of the type II error, yielding a restrictive/low threshold for the strict ED rule adoption: $\widetilde{\sigma} \geq Max(\sigma_R^*, \overline{\sigma})$. In this case, the possibility of remedies in addition to ED 'hastens' the application of the ED, because the CA does so (under the form of the flexible ED rule) as soon as the quality information exceeds $Max(\sigma_R^*, \overline{\sigma})$, rather than $\widetilde{\sigma}$ as in the case of a strict ED rule. In both configurations, for the lowest quality signals, the CA will not allow an ED, but will only apply the remedy decision rule.

To better seize the result given in Proposition 5.2, we remind that the choice between an ED rule (either strict or flexible) and remedy gives rise to a trade-off between the incentive effect and the type II error effect, whose result depends on the signal quality (the benefit of an ED rule being to provide incentives to exert ex-ante the effort, while its cost being to lead the CA to accept an inefficient merger because of the signal imperfection). Furthermore, the comparison between the two ED rules given in Lemma 5.2 indicated that while the strict ED rule provides higher effort incentives than the flexible ED rule, the latter can lead insiders to signal their merger type, thus possibly avoiding the approval of inefficient mergers. More precisely, the flexible ED rule induces this self-selection for a sufficient signal quality ($\sigma \geq \overline{\sigma}$), thus providing both gives incentives and improved expected welfare for an information quality above $Max(\sigma_R^*, \overline{\sigma})$. The result in Proposition

5.2 can be explained based on these two effects as follows.

If the cost of type II error is prohibitive (a very low level of $W(\underline{e})$), the threshold $\widetilde{\sigma}$ is high in itself, meaning that the quality of information required to make tolerable from the welfare viewpoint the risk to accept an inefficient merger is high. In that case, the flexible ED rule is preferable to the strict ED because when applied, it induces insiders to signal their merger type and thus it prevents the clearance of inefficient mergers. That is why whenever $\widetilde{\sigma} \geq Max(\sigma_R^*, \overline{\sigma})$, by allowing the flexible ED rule as soon as $\sigma \geq Max(\sigma_R^*, \overline{\sigma})$, the CA actually widens up the interval of signal quality warranting the adoption of an ED. This is strictly preferred by the CA, because throughout this extended ED adoption range, maximizing welfare is obtained while eliminating the very costly type II error.

If instead $\widetilde{\sigma} < Max(\sigma_R^*, \overline{\sigma})$, then the incentive effect of the ED dominates the type II error effect for the intermediary range of signal quality $\sigma \in (\widetilde{\sigma}, Max(\sigma_R^*, \overline{\sigma}))$. This is the case whenever the potential negative welfare effect $W(\underline{e})$ is actually not too prohibitive in itself ($W(\underline{e})$ not much inferior to W_i). In this configuration the CA prefers to start allowing the ED in the form of the the strict ED rule rather than the flexible one, since the former makes firms exert effort for lower information quality than the latter. Still, when the information quality is so high that under the flexible ED insiders both exert effort as well as signal their type upon notification, i.e. for $\sigma \geq Max(\sigma_R^*, \overline{\sigma})$, the type II error effect becomes dominant, and leads the CA to adopt the flexible ED rule. That is why in both configurations, whenever σ is higher than $Max(\sigma_R^*, \overline{\sigma})$, the CA always adopts the flexible ED rule.

The adoption of an ED gives rise to errors, and the commitment to either allow or prohibit remedies is likely to impact on both types of error. *We obtain here that the combined application of ED and remedy is relatively more valuable from the point of view of the outcome of merger control when type II errors are particularly costly, whereas the policy aimed at minimizing the cost of type I errors requires to refrain from remedies and adopt a strict ED rule.* Incidentally, this responds to the warning (Christiansen (2006)) that the importance of type II errors will increase following the explicit ED acknowledgement within the 2004 European Merger Regulation.

5.3 Conclusion

This chapter draws attention to the likely consequences of the adoption of an ED procedure, given the general current context of its application, i.e. asymmetric information for the CA, and generalized use of merger remedies. The former point was actually invoked to delay the European ED, by arguing costly implementation issues. We claim here that a possible *ex ante* positive effect, in the shape of incentives to encourage more efficient mergers, should equally be accounted for, despite the asymmetric information problem. The second point is intimately related to the first, due to the interaction between remedy and ED. The examination of this interplay is the original and more important contribution of our paper. We study the impact of remedy on the incentive provided by and the outcome of the ED, and conclude on the opportunity of combining the two, depending on the quality of information underlying the merger assessment.

5.4 Proofs

Proof of Proposition 5.1. When the strict ED is allowed, firms have incentives to exert the costly effort as long as

$$q\left(\sigma\Pi(\overline{e})+(1-\sigma)\Pi_i\right)+(1-q)((1-\sigma)\Pi(\underline{e})+\sigma\Pi_i)-F\geq(1-\sigma)\Pi(\underline{e})+\sigma\Pi_i)$$

Define σ^* such that $((\sigma\Pi(\overline{e})+(1-\sigma)\Pi_i))-((1-\sigma)\Pi(\underline{e})+\sigma\Pi_i))\equiv\frac{F}{q}$.

The LHS term being increasing with σ, for $\sigma\geq\sigma^*$ firms exert effort under the strict ED rule.

From the CA's point of view, the strict ED decision rule yields a higher expected welfare than the alternative, remedy decision rule, iff

$$q(\sigma W(\overline{e})+(1-\sigma)W_i)+(1-q)(\sigma W_i+(1-\sigma)W(\underline{e}))\geq W^R(\underline{e})$$

Define $\widehat{\sigma}$ such that $q(\sigma W(\overline{e})+(1-\sigma)W_i)+(1-q)(\sigma W_i+(1-\sigma)W(\underline{e}))\equiv W^R(\underline{e})$

The LHS term is increasing with σ, so for $\sigma\geq\widehat{\sigma}$, the strict ED decision yields a higher expected welfare.

Define $\widetilde{\sigma}=\max\left(\sigma^*,\widehat{\sigma}\right)$; for $\sigma\geq\widetilde{\sigma}$ the CA is better off allowing the strict ED; otherwise, it prefers to stick to the remedy decision rule and does not allow the strict ED. ■

Proof of Lemma 5.1. At the 3rd stage, insiders having succeeded the effort to achieve the EG will submit merger with remedy iff

$$\sigma\Pi(\overline{e}) + (1-\sigma)\Pi_i < \Pi^R(\overline{e}) \Leftrightarrow \sigma < \frac{\Pi^R(\overline{e}) - \Pi_i}{\Pi(\overline{e}) - \Pi_i} = \widehat{\sigma}^e$$

Insiders without EG will submit merger with remedy iff

$$\sigma\Pi_i + (1-\sigma)\Pi(\underline{e}) < \Pi^R(\underline{e}) \Leftrightarrow \sigma > \frac{\Pi(\underline{e}) - \Pi^R(\underline{e})}{\Pi(\underline{e}) - \Pi_i} = \widehat{\sigma}$$

Define $\underline{\sigma}$ such that $\underline{\sigma} = \min(\widehat{\sigma}^e; \widehat{\sigma})$ and $\overline{\sigma}$ such that $\overline{\sigma} = \max(\widehat{\sigma}^e; \widehat{\sigma})$

For $\sigma < \underline{\sigma}$, only the efficient insiders propose remedy with their merger, whereas for $\sigma > \overline{\sigma}$ only the inefficient do so. For intermediate quality signals, either both types propose remedies, or neither. ■

Proof of Lemma 5.2. Effort choice (Stage 2 decision)

Following Lemma 5.1, for $\sigma < \underline{\sigma}$, only the efficient insiders propose remedy with their merger, therefore effort is made iff

$$q\Pi^R(\overline{e}) + (1-q)((1-\sigma)\Pi(\underline{e}) + \sigma\Pi_i) - F \geq ((1-\sigma)\Pi(\underline{e}) + \sigma\Pi_i)$$
$$\Leftrightarrow q\left(\Pi^R(\overline{e}) - ((1-\sigma)\Pi(\underline{e}) + \sigma\Pi_i)\right) \geq F$$

For $\underline{\sigma} < \sigma < \overline{\sigma}$, either all mergers are submitted with remedy or none;

- if both types propose remedy, effort is made whenever

$$q\Pi^R(\overline{e}) + (1-q)\Pi^R(\underline{e}) - F \geq \Pi^R(\underline{e}) \Leftrightarrow q\left(\Pi^R(\overline{e}) - \Pi^R(\underline{e})\right) \geq F$$

but this contradicts the initial assumption, so effort is never undertaken!

- if neither type proposes remedy, then effort is made iff

$$q(\sigma\Pi(\overline{e}) + (1-\sigma)\Pi_i)) + (1-q)((1-\sigma)\Pi(\underline{e}) + \sigma\Pi_i) - F \geq (1-\sigma)\Pi(\underline{e}) + \sigma\Pi_i)$$
$$\Leftrightarrow q[((\sigma\Pi(\overline{e}) + (1-\sigma)\Pi_i)) - ((1-\sigma)\Pi(\underline{e}) + \sigma\Pi_i))] \geq F$$

Finally, for $\sigma > \overline{\sigma}$ only the inefficient firms propose remedy (and thereby self-select), so effort is made iff

$$q(\sigma\Pi(\overline{e}) + (1-\sigma)\Pi_i)) + (1-q)\Pi^R(\underline{e}) - F \geq \Pi^R(\underline{e})$$
$$\Leftrightarrow q(\sigma\Pi(\overline{e}) + (1-\sigma)\Pi_i) - \Pi^R(\underline{e})) \geq F$$

Comparison of effort incentives w.r.t. the benchmark situation, i.e. between the "flexible" and the "strict" ED:

The condition ensuring effort if $\sigma < \underline{\sigma}$ is given by:

$$\begin{cases} \text{"flexible"} \Rightarrow q\left(\Pi^R(\overline{e}) - ((1-\sigma)\Pi(\underline{e}) + \sigma\Pi_i)\right) \geq F \\ \text{"strict"} \Rightarrow q\left[(\sigma\Pi(\overline{e}) + (1-\sigma)\Pi_i) - ((1-\sigma)\Pi(\underline{e}) + \sigma\Pi_i))\right] \geq F \end{cases}$$

$\Rightarrow$ the flexible regime yields higher effort incentive than the strict one because the corresponding condition is less strict, due to $\Pi^R(\overline{e}) > (\sigma\Pi(\overline{e}) + (1-\sigma)\Pi_i)$ for $\sigma < \widehat{\sigma}$ (see Lemma 5.1). However, for $\sigma < \widehat{\sigma}$, one equally has $(1-\sigma)\Pi(\underline{e}) + \sigma\Pi_i) > \Pi^R(\underline{e})$, therefore $\left(\Pi^R(\overline{e}) - ((1-\sigma)\Pi(\underline{e}) + \sigma\Pi_i)\right) < \left(\Pi^R(\overline{e}) - \Pi^R(\underline{e})\right)$ which in its turn $< \frac{F}{q}$ by assumption. The bottom line is that effort is never undertaken for $\sigma < \underline{\sigma}$, and consequently we can state that $\underline{\sigma} < \sigma^*$, where σ^* was defined as the threshold for effort exertion under the strict ED (see the proof of Proposition 5.1).

If $\underline{\sigma} < \sigma < \overline{\sigma}$, the condition ensuring effort is

$$\begin{cases} \text{"flexible"} \Rightarrow \begin{cases} \text{either } q\left(\Pi^R(\overline{e}) - \Pi^R(\underline{e})\right) \geq F, \text{ if firms propose to remedy} \\ \text{or } q\left[((\sigma\Pi(\overline{e}) + (1-\sigma)\Pi_i)) - ((1-\sigma)\Pi(\underline{e}) + \sigma\Pi_i))\right] \geq F, \text{ otherwise} \end{cases} \\ \text{"strict"} \Rightarrow q\left[(\sigma\Pi(\overline{e}) + (1-\sigma)\Pi_i) - ((1-\sigma)\Pi(\underline{e}) + \sigma\Pi_i))\right] \geq F \end{cases}$$

$\Rightarrow$Since $q\left(\Pi^R(\overline{e}) - \Pi^R(\underline{e})\right) \geq F$ is impossible, so no effort is made in this case, we conclude that the two ED decision rules are equivalent in terms of incentives, provided that under the flexible ED types do not pool on proposing remedy; otherwise, the strict ED yields higher effort incentives that the flexible one.

Finally, for $\sigma > \overline{\sigma}$ the conditions ensuring effort exertion are respectively

$$\begin{cases} \text{"flexible"} \Rightarrow q\left(\sigma\Pi(\overline{e}) + (1-\sigma)\Pi_i) - \Pi^R(\underline{e})\right) \geq F \\ \text{"strict"} \Rightarrow q\left[((\sigma\Pi(\overline{e}) + (1-\sigma)\Pi_i)) - ((1-\sigma)\Pi(\underline{e}) + \sigma\Pi_i))\right] \geq F \end{cases}$$

$\Rightarrow$Given that $\Pi^R(\underline{e}) > ((1-\sigma)\Pi(\underline{e}) + \sigma\Pi_i))$ for $\sigma > \overline{\sigma}$ (see Lemma5.2 for the self-selection effect), we conclude that the flexible regime provides lower effort incentives than the strict one.

Conclusion: denoting by σ_R^* the signal quality threshold such that for $\sigma \geq \sigma_R^*$ insiders undertake the effort under the flexible ED, the outcome of the above incentive comparison can be summarized as follows: $\sigma_R^* \geq \sigma^*$ throughout $\underline{\sigma} < \sigma < \overline{\sigma}$, and $\sigma_R^* > \sigma^*$ for $\sigma > \overline{\sigma}$. To sum up, we obtain that $\sigma_R^* \geq \sigma^*$. ■

Proof of Proposition 5.2. To conclude on the optimal decision rule to adopt, depending on the quality of available information, we compare the expected welfare levels. Hence we need first compare the relevant threshold for the adoption of the strict, and respectively flexible, ED decision rules.

Following Proposition 5.1, the adoption threshold for the strict ED rule is $\widetilde{\sigma}$. By the same token, the relevant threshold for the adoption of the flexible ED rule is $Max(\sigma_R^*, \overline{\sigma})$, because under this rule firms exert effort for σ_R^*, (see Lemma 5.2), whereas for $\sigma > \overline{\sigma}$ the self-selection effect (see Lemma 5.1) guarantees that no inefficient merger is accepted. Therefore, for $\sigma \geq Max(\sigma_R^*, \overline{\sigma})$ the flexible ED is optimal from the point of view of the expected welfare, because it actually yields the highest possible expected welfare (thanks to both effort exertion and elimination of type II errors).

The adoption thresholds for the strict and respectively flexible ED rules are entirely independent/unrelated, therefore two cases are possible and need to be considered: either $\widetilde{\sigma} < Max(\sigma_R^*, \overline{\sigma})$, or $\widetilde{\sigma} \geq Max(\sigma_R^*, \overline{\sigma})$.

In terms of expected welfare, when the CA applies the remedy decision rule it obtains $W^R(\underline{e})$. As soon as the strict ED rule is allowed, it yields an expected welfare of $q(\sigma W(\overline{e}) + (1-\sigma)W_i) + (1-q)(\sigma W_i + (1-\sigma)W(\underline{e})$, whereas the flexible ED improves the expected welfare to $q\left(\sigma W(\overline{e}) + (1-\sigma)W_i\right) + (1-q)W^R(\underline{e})$ whenever adopted. ■

Chapter 6

Crafting and negotiating divestiture contracts to reveal the merger efficiency gains

Truth is the safest lie.

(Jewish proverb)

This chapter is based on "Merger Control with Asymmetric Information: What Remedies Can and Cannot Achieve", Cahiers de la MSE n° 2005 - 47, co-authored with Jean-Philippe Tropéano.

6.1 Introduction

When dealing with an anti-competitive merger, to answer the question "how can the competition threat be best eliminated" the Competition Authority (CA) has basically the choice between rejecting it or accepting it provided that corrective remedies are adopted. The 2005 Remedy Study of the European Commission DG Comp[1] counted no less than 190 concentrations cleared with commitments from a total of 2469 mergers since the introduction of the EC Merger Regulation in 1990. It might look like a small number, but a closer look at the Commission's statistics reveals that remedies typically apply to consequential mergers[2]. Moreover, about 80% of those commitments address horizontal concerns. Divestitures, i.e. structural remedies, are typically used to modify horizontal mergers, and account for more than 60% of all remedies. They are preferred to behavioral ones, because they change the allocation of property rights within the industry, and therefore need no monitoring once implemented. Nevertheless, their application and effects have often been subject to questioning, because as Blumenthal (2001) puts it, "the fashioning of merger remedies is not materially governed by case law [and therefore] is subject to standards that are not well-defined or consistent".

6.1.1 Purpose and relevance

This chapter aims to contribute to the economic analysis of structural merger remedies by taking into account the merger's potential efficiency gains for their design. Our model formalizes the intuition of a link between the amount of efficiency gains that the merging partners can achieve and the amount of assets they will have to divest for the merger to be accepted. Such an idea is in line with the current consensus among competition policy practitioners, according to which the remedy should neither exceed the net competitive harm caused by the merger, nor prove insufficient to correct it (that is, both overfixing

[1] Merger Remedies Study, European Commission, DG Comp, October 2005, available at http://europa.eu.int/comm/competition/index_en.html

[2] Examples for such mergers, cleared with commitments under the new European Merger Regulation 139/2004, are Pernod Ricard - Allied Domecq, Sanofi - Aventis, Alcan - Pechiney.

and underfixing should be avoided[3]). According to this 'proportionality' principle, the remedies as "commitments should be proportionate to the competition problem and entirely eliminate it " (the 2004 ECMR, paragraph 30). Taking into account the fact that by balancing the potential efficiencies of the merger against its anticompetitive potential CAs evaluate the net competition concern of the merger, the proportionality requires that a larger divestiture be requested from a less efficient merged entity than from a more efficient one, because the former raises a more important net competition concern. The essential point is that in order to tailor the optimal remedy accordingly, the CA needs to learn the efficiency gains generated by the merger, which are private information of the merger partners.

Considering this, *the second objective of this chapter is to shed light on the design of optimal divestiture contracts when merging firms are better informed than the CA with respect to the merger efficiencies.* While the US Merger Guidelines do acknowledge that "mergers have the potential to generate significant efficiencies", they warn at the same time that "efficiencies are difficult to verify and quantify, in part because much of the information relating to efficiencies is uniquely in the possession of the merging firms"[4].

Understandably, competition authorities are likely to try and extract this private information. Röller et al. (2001) suggested that a possible "approach in screening mergers would be to implement a revelation mechanism through the institution of merger license fees to be paid to the government", but they equally acknowledge that for the time being, this is strictly theoretical[5]. In practice, the only revelation procedure implemented to date concerns a bonding procedure based on an *ex post* verification of efficiency claims. Thus, Brodley (1996) quotes it as a powerful way to extract private information on efficiency gains, whose effectiveness was proved in the Pennsylvania versus Providence Health Sys., Inc. case[6], where the consent decree negotiated between the Pennsylvania Attorney

[3] See the Antitrust Division Policy Guide to Merger Remedies, by the U.S. Department of Justice, October 2004, and the Commission Notice on remedies acceptable under Council Regulation (EEC) No 4064/89 and under Commission Regulation (EC) No 447/98, Official Journal C68, 2.3.2001.

[4] See the Horizontal Merger Guidelines, available at http://www.usdoj.gov/atr/public/horiz_book/4.html

[5] Röller et al. (2001) report that small merger licence fees have been used in the UK, but not for screening purposes - to our knowledge, this is the only stance were the use of licence fees is quoted.

[6] See more details in O'Connor, FTC Hearings, "Efficiencies: Should Current Antitrust Pol-

General and the merging parties provided that if the alleged efficiencies did not translate into net cost savings directly passed on to consumers five years later, the merging parties engaged to pay to the Treasury the shortfall from the claimed efficiency gains.

We do not formalize here the implications of such a "put-up-or-shut-up" consent decree based on *ex post* control. In turn, we model a competition authority extracting *ex ante* the parties' private information w.r.t. the efficiency gains so as to tailor the optimal structural remedy. *To do so, we propose a revelation mechanism combining the use of divestitures with the regulation of their sale prices.* Rather than asking "What role, if any, should a competition authority play in the pricing of assets to be divested?"[7], we examine here the very rationale for interfering with the pricing of the divested assets, given the necessity to identify a viable revelation mechanism.

For the time being, competition authorities do not tamper with the sale price of the divested assets, although a complementary screening device in addition to divestitures might prove necessary for an effective revelation mechanism to screen merger proposals. Their reluctance must be motivated by the fact that interfering with prices is basically a regulator's job[8]. Generally speaking, competition authorities resists becoming *de facto* regulators because they typically lack the staff, culture and set of instruments required of such a role. Nevertheless, merger control is by definition a mixed area of antitrust and regulation, where the CA is actually supposed to directly impact on the market structure by rejecting anticompetitive mergers (see Motta et al. (2003) and Rey (2003)). One might equally note that the scope of instruments employed has constantly increased, with structural remedies themselves being actively and properly used as a merger policy tool as late as 1976 with the Hart-Scott-Rodino Act[9]. Furthermore, whenever the CA appoints a divestiture trustee, merger control comes quite close to an indirect pricing of the divested

icy Be Changed?" November 7, 1995, available at http://www.abanet.org/antitrust/committees/state-antitrust/efficiencies.pdf

[7] See the OECD report on Merger Remedies, DAF/COMP(2004)21, December 2004, p.33.

[8] It is widely known for instance that competition authorities prefer structural remedies to behavioural ones because the latter involve *ex post* monitoring, which they would rather avoid.

[9] See the Baer and Redcay (2003) comments on the implications of the Hart-Scott-Rodino Antitrust Improvements Act of 1976.

assets: according to the ECMR[10], a trustee is entitled to organize the sale of the divested assets without a minimum price, subject though to the Commission's approval. In related fields, setting prices might equally be relevant, such as in punishing market power abuses [11], or to deal with intellectual property rights[12].

The point we wish to make is that, notwithstanding competition laws do not currently allow antitrust agencies to explicitly fix the price of divestitures, the latter might nevertheless reveal private information in the remedy negotiation process[13]. This idea would provide an alternative, equivalent and appealing signaling-like interpretation for our revelation mechanism, according to which a more efficient merged entity will accept a lower price for any given level of divestiture and it will successfully signal itself as such by doing so, in contrast with a less efficient entity. Our model argues in favour of the signalling properties of a divestiture contract comprising the divested assets sale price, although to do so we take a screening stand. We show the theoretical relevance of such an instrument, although in practice, despite the apparent eagerness of merging parties to convey information through the divestiture sale price, the competition agencies refrain from interpreting it as a valid signal. After all, commenting on the proposed merger between Staples and Office Depot including a divestiture offer, the Washington Post dated March 13, 1997 did note that "Because all three office product chains would benefit from the merger, and with pressure from shareholders mounting, analysts said Staples agreed to accept about $140 million less than it originally wanted from Office Max " (i.e. the proposed buyer of divested assets), but still, the FTC challenged the merger and eventually gained in court.

[10] See the Commission notice on remedies acceptable under Council Regulation, No 4064/89 and under Commission Regulation (EC) No 447/98, Official Journal C 68, 02.03.2001

[11] According to the Wall Street Journal Europe, May 26, 2005, in the battle to force Microsoft to open up the market for media-playing software, the European Commission would rather order a lower price for Windows without Media Player

[12] Llobet et al. (2000) propose a "buy out" mechanism, where the price of the patent licence would be set by the Patent Office.

[13] See Farrell (2003) for this intuition.

6.1.2 Outline of model and results

Our model builds on a simple framework, which nevertheless allows for a consistent formal treatment of both efficiency gains and structural remedies. We consider a Cournot competition game with homogenous good, constant marginal costs and capacity constraints in a three-firm industry. Following a two-firm exogenous merger, the merged entity may enjoy efficiency gains materializing as cost savings. Still, the merger may raise an anticompetitive concern, therefore to fulfill its anti-trust relief objective, the CA will require an asset transfers to the outsider. Divestitures alter the distribution of capital assets between firms and thereby the capacity constraints and merger profitability for firms in the industry. We look for the optimal transfer to implement according to the objective of the CA: maximizing total welfare under the constraint that the Consumers' Surplus does not fall. We show that with symmetric information the optimal divestiture will be proportional to the level of the competitive damage, meaning that less efficient mergers will need to divest more. But since the cost savings are private information for merging partners (also called insiders), the latter are likely to cheat when declaring the amount of efficiency gains generated by the merger, so as to avoid higher asset transfers. Thus the divestiture alone will not be effective as a screening device.

We argue here that a non linear tariff for the divested assets can be successfully employed as a screening mechanism. Specifically, we use a two-type model, where the insiders are either highly efficient (low-cost) or poorly efficient (high-cost). We show that the divestiture deal that the CA proposes to the merged entity is a menu of two contracts. The first contract consists of a lower divestiture for a lower average sale price than the second one. The efficient merged entity values its capacity more than the inefficient one does, therefore it is more reluctant to divest a large quantity of assets than the high-cost merged entity, even though the corresponding monetary transfer is high. By the same token, since assets have lower value for the inefficient merged firm, the latter will find it profitable to divest a large quantity of assets for a higher average price.

In other words, the CA clears the merger provided the merged entity pays a "licence to merge", although not to the CA, we should stress, since the monetary transfer actually takes place between the insiders and the buyer of divested assets. The optimal licence

schedule proposed by the CA takes two forms. Firms 'pay' either by divesting a large quantity of assets in exchange of a high sale price, or by accepting a depreciated price in exchange of a lower asset transfer. Hence the licence is essentially either a monetary payment whenever few assets are divested at a low price, or an asset payment whenever a large quantity of assets is divested. Facing these two possible types of licences to merge, the more efficient merged entity is induced to choose the least distorting form of payment, the monetary one. Our model basically shows the effectiveness of a screening contract menu based on the sale price of divested assets, so it implicitly argues that such divestiture contracts listing both the amount and price of divestiture could be used by merging firms to successfully signal their efficiency claims. Notwithstanding the reluctance of competition authorities to openly interfere with the pricing of the divested assets, close attention should be paid to the asset prices as they result from the divestiture negotiation process, since they may very well contribute to signalling the merger potential synergies.

6.1.3 Related literature

It was early noted that "In merger review, the selective provision of information creates problems for government antitrust officials because much relevant information is held privately by merging parties" (Yao and Dahdouh (1993, p.24)). Faulli-Oller and Corchon (1999) examined for instance the possibility to implement socially optimal mergers, in spite of this asymmetric information problem, based on standard tools in dominant strategy implementation. They do obtain that this would not be successful, but without allowing for one essential merger policy tool, namely remedies.

To our knowledge, few papers do so. Our model allows for divestitures, besides their corrective role, to be used for screening purposes. Gonzalez (2003) was the first to propose a formal setting for this intuition, in a model where the incentive mechanism combines the obligation to divest assets with the choice of the market where the divestiture will apply if accepted. As compared with Gonzalez (2003), our mechanism restricts the use of divestiture to the same market on which the competitive harm occurs, and is also thoroughly effective - we obtain perfect revelation in addition to complete relief of the competitive concern. In so doing, we basically formalize the intuition that the amount

of asset transfer necessary to remedy the competitive harm depends on the amount of efficiency gains generated by the merger, and thanks to the capacity constraint framework, the distortion of asset transfers is not necessary to induce information revelation. Neither of these are obtained for instance in the case of the screening mechanism proposed by Féral (2006), combining the use of remedies with the payment of a tax on the divestiture to the financial market supervising authority, although the starting intuition (i.e. a licence to merge) is arguably the same as in our case.

At this point some remarks are necessary, to the extent that this chapter proposes the first contribution to date which explicitly considers, for the analysis of a merger's unilateral effects, the role of remedies in relation with the firms' capacity constraints. By considering capacity constraints, we underline the necessary condition for a divestiture to prove effective, namely that the transferred assets should be really used by the purchaser to increase output and thereby keep the market price low. If the asset buyer already holds slack capacity, the divestiture will only enhance the merger's anti-competitive output-contraction effect. This cannot be accounted for in a model without capacity constraints. On the other hand, our framework enables the modelling of remedies which do not undermine the efficiencies that the transaction is designed to achieve. Indeed, if the asset holdings available to a firm entirely determine its marginal cost (which is, actually the main feature of the widely used cost framework *à la* Perry and Porter (1985)), then requiring a remedy divestiture from the merging firms will affect any efficiency gains generated by the increased amount of jointly-owned capital. Finally, this neutrality of the asset transfers w.r.t. the efficiencies allows us to better highlight the particular nature of relevant merger efficiencies (synergies are not mere capital-based cost savings). Note also that this dichotomy between divestiture and efficiencies does not interfere with the proportionality between the optimal necessary divestiture and the net competitive concern of the merger. In contrast, both Medvedev (2004,a) and Féral (2006) explicitly assume substitutability between the capital-based cost-savings and the merger synergies, as a result of which a more efficient merged entity will afford to divest more - in Féral's (2006) asymmetric information model, this implies that rightful efficiency claims get signalled by the divestiture of more assets, so the remedy goes beyond competitive relief and thereby generates productive inefficiency.

Since it deals with structural remedies, the analysis proposed in this chapter also belongs to a strand of literature analyzing the effects of capital transfers between firms. After Farrell and Shapiro (1990,b), which examined how capital transfers between Cournot oligopolists affect total industry profit or welfare, Compte et al. (2002) and Vasconcelos (2005,a) looked into the effects of asset transfers, but from a collusive industry point of view. We completely rule out coordinated effects, and focus only on the unilateral effects of the concentration. The same was done, but in a symmetric information framework, by Medvedev (2004,a) and Vasconcelos (2005,b), who moreover share the same modeling choice of marginal cost decreasing with capital holdings *à la* Perry and Porter (1985).

The remaining of the chapter is organized as follows. We present first the market equilibria both before and after merger, taking simultaneously into account efficiency gains as well as asset transfers. We then go on to present the game between industry firms and the CA. For the design of optimal remedies, we define first the symmetric information benchmark, then deal with the asymmetric information framework. Finally, we comment our results and conclude on their relevance and limitations. Technical proofs are grouped in the final section.

6.2 The model

We present first the pre-merger equilibrium as a benchmark and then the post-merger framework.

6.2.1 Pre-merger market equilibrium

We consider as starting point a homogenous good, three-firm perfectly symmetric industry. Demand is linear: $P(Q) = 1 - Q$, where Q is total output. Firms maximize individual profit. We place ourselves in a situation where firms face capacity constraints *à la* Dixit (1980). Explicitly, we assume that a two-stage capacity-quantity game took place before merger, where firms acquire first capacity at a positive unit cost c_k and then compete in quantities with identical constant production marginal costs equal to c. The Subgame Perfect Equilibrium of such a game is given by capacity and output equal to

$\frac{1-c-c_k}{4}$. We take this to be the operational capacity of a firm before merger and denote it by k. Consequently, pre-merger equilibrium yields $Q = 3k$ and $P(3k) = 1-3k$. We denote Π the pre-merger individual profit, which writes $\Pi = k(1-3k-c)$. We assume that the unit cost for the acquisition of additional capacity is prohibitive in the short-run (i.e. for the duration of the merger game).

6.2.2 Post-merger market framework

Since we only deal with exogenous market concentration, and that initially the three firms are identical, merger is assumed to take place between any two of them. We index the merged entity, i.e. the insiders, by M, and the outsider by o respectively.

Following the merger, M's capacity constraint changes, since now it holds the double of the pre-merger capacity. As far as the outsider is concerned, its capacity is unchanged, as well as its marginal cost. The insiders in turn may benefit from merger-specific cost savings[14]. More precisely, the marginal cost of the merged firm, denoted c_M, satisfies the following: $c^M = c - \alpha$, where $\alpha \in [0, c]$ measures the amount of cost savings. Our framework is general enough to lend itself to different interpretations of this parameter. For instance, α stands for the synergies that arise from the merger, i.e. substantial efficiency gains that would not have been obtained without it. More generally, α measures the positive effect of an essential complementarity between the merger partners that allows them to lower their common marginal cost[15]. Following Röller et al. (2000), these synergies can typically be due to complementarity between technological or administrative capabilities of firms. For example, firms may own complementary patents, which, if jointly used, further improve the production process.

In the post-merger framework, firms play a standard Cournot game - we rule out in our model any possibility for post-merger collusion. Firms obey the following capacity constraints[16]: $q^M \leq 2k$ and $q^o \leq k$. Taking into account the cost savings for the merged

[14] Our treatment of cost savings deals with the marginal cost, so as to consistently follow the current CAs' treatment of allowable merger efficiency gains.

[15] For an explicit example of modeling cost savings through the use of complementary assets by merger partners see Bensaid et al. (1994)

[16] We consider here that in the short run firms cannot increase their production capacity. This result

entity, firms' Best Reply functions write $BR^M(q^o) = \min\left(\frac{1+\alpha-c-q^o}{2}, 2k\right)$ and $BR^o(q^M) = \min\left(\frac{1-c-q^M}{2}, k\right)$ respectively. It is straightforward to show that post-merger equilibrium price is less or equal to $P(3k)$ only if $\alpha \geq 5k-1+c$. In other words, a merger will increase market price whenever its cost savings fail to exceed this minimum threshold.

In short, mergers have an ambiguous impact on the economy. On the one hand, if the efficiency gains are sufficiently important (see the above threshold), then the merged entity is induced to use all its productive capacity and thus the price is unchanged with respect to its pre-merger level. In turn, with lower efficiency gains, the insiders will hold slack capacity and the price will be higher than its pre-merger level. In such a case, divestitures might be used by the CA to modify the post-merger market equilibrium so as to prevent any drop in Consumers' Surplus. Such remedies would depend on the efficiency gains, and their crafting is studied in the next section.

6.3 Remedies as a screening device

6.3.1 Objective of merger control and terms of divestiture

As far as the CA's objective goes, we assume total welfare maximization under the constraint of no drop in Consumers' Surplus. The essential feature of the CA's objective is actually the second condition, which closely follows the current trend in merger control in as much as CAs accept or reject mergers based on the price increase likelihood. To put it short, a merger is approved if consumers will not be hurt, which is what we require in our model. Note that thanks to the capacity constraint setting, this requirement is strictly equivalent to maximizing Consumers' Surplus, because the industry output can never actually exceed the pre-merger level[17]. We go beyond and look for the welfare maximizing divestiture so as to be able to identify the least distorting asset transfer from the point of view of productive efficiency (i.e. the one that will prove the less harmful to firms' profits).

remains true as long as the unit cost of capacity acquisition c_k is high enough, which is precisely our assumption here.

[17] See Besanko and Spulber (1993), Neven and Röller (2005), and Lyons (2002) for theoretical contributions supporting the choice of a pure Consumers' Surplus standard instead of the Total Welfare.

In order to account for the possible anti-competitive merger effects, we use a two-type model, with the synergy parameter denoted $\alpha, \alpha \in \{\underline{\alpha}, \overline{\alpha}\}$, where $\underline{\alpha}$ stands for the large marginal cost reduction (high efficiency gains), and $\overline{\alpha}$ for the small marginal cost savings (low efficiency gains). Explicitly, $\underline{\alpha} = c - \underline{c}^M$ and $\overline{\alpha} = c - \overline{c}^M$, where $\underline{c}^M$ and $\overline{c}^M$ are the marginal costs of the low-cost merged firm and of the high-cost one respectively. Objective probabilities for the two types are ρ and $1 - \rho$ respectively.

In our setting, divestitures will consist in transfers of assets to the outsider, whom we consider here to be the only possible buyer[18]. We make this hypothesis for the sake of simplicity, but the framework lends itself well to the introduction of a new entrant on the market[19].

We go on next to determine first the optimal divestiture when information on the merger type is symmetric, so as to examine afterwards the role of asymmetric information for the design of the merger divestiture remedy.

6.3.2 Optimal divestitures with symmetric information

Given the screening stand we take in our model, the game we consider between the firms and the CA is the following:

In the first stage, the merging firms learn their efficiency gains level α and submit a merger proposal to the CA. When information is symmetric the parameter α is also observed by the outsider and by the CA. (Later on we detail the information structure of the game with asymmetric information).

In the second stage, the CA evaluates the consequences of the merger taking into account its own merger control objective. It proposes a divestiture contract accordingly, if such a contract exists; if not, it rejects the merger.

[18] The FTC's 1999 Divestiture Study explicitly and on purpose quotes West Texas Transmission, L.P. vs. Enron Corp. as confirming the FTC's authority to choose the divestiture buyer.

[19] This would nevertheless go beyond the primary purpose of our model, since it would require the specification of the entrants' marginal cost and a detailed case discussion to determine then the optimal asset buyer from the CA's pont of view. Moreover, by not allowing entry on the market, we want to remind that besides capacity, a certain know-how and experience of the market are necessary to guarantee actual competition on behalf of the buyer of divested assets.

In the third stage, the insiders accept or reject the divestiture. If they accept, assets will be transferred to the outsider on a take-it-or-leave-it basis.

In the fourth stage, the outsider decides whether to take over or not the divested assets.

In the fifth stage, conditional on the divestiture contract being accepted, the Cournot market equilibrium is determined taking into account the amount of asset transfer required by the CA. If any of the parties rejects the contract, the merger project falls through.

This last assumption is quite in line with the current unfolding of a divestiture negotiation process. Indeed, whenever a divestiture injunction is being settled upon, it has previously gained approval of all involved parties: the divesting firms, the buyer, and the CA. The failure of such a three-party negotiation typically results either in the appointment of a divestiture trustee[20], or in the merger itself falling through[21].

At the last stage of the game, firms play a standard Cournot game. Before the divestiture requested by the CA, firms' capacities amounted to $2k$ for M and k for o. Once an amount Δ of assets are transferred from M to o, firms will obey the following capacity constraints: $q^M \leq 2k - \Delta$ and $q^o \leq k + \Delta$. Taking into account both the cost savings and the required divestiture, the Best Reply functions of the Cournot game now write as follows: $BR^M(q^o) = \min\left(\frac{1+\alpha-c-q^o}{2}, 2k - \Delta\right)$ and $BR^o(q^M) = \min\left(\frac{1-c-q^M}{2}, k + \Delta\right)$.

Profits are denoted $\Pi^M(\Delta;\alpha)$ and $\Pi^o(\Delta;\alpha)$ respectively, and depend on the cost savings parameter α and the amount of divestiture Δ. Therefore, for a given divestiture $0 \leq \Delta \leq (1-c) - 4k$, i.e. not too high so as to have the outsider operate at full capacity,

[20] "According to FTC staff, as of June 30, 2002, [...]In Aventis, Docket C-3919, FTC required divestiture of the alternate assets and appointed a trustee to accomplish the divestiture when the merging parties failed to divest the original assets on time" - p.86 of the FTC's 2002 "Study Needed to Assess the Effects of Recent Divestitures on Competition in Retail Markets".

[21] The European Commission DG Competition's site provides statistics on the outcome of merger review process: since 1990, 27 mergers were abandoned following a Phase II examination, i.e. when having to cope with the commitments requested by the Competition Authority.

profits write

$$\Pi^M(\Delta;\alpha) = \begin{cases} \left(\frac{1+\alpha-c-k-\Delta}{2}\right)^2, \text{ if } \alpha \leq 5k-\Delta-(1-c) \\ (1-3k-c+\alpha)(2k-\Delta), \text{ if } \alpha > 5k-\Delta-(1-c) \end{cases} \tag{6.1}$$

$$\text{and } \Pi^o(\Delta;\alpha) = \begin{cases} \left(\frac{1-\alpha-c-k-\Delta}{2}\right)(k+\Delta), \text{ if } \alpha \leq 5k-\Delta-(1-c) \\ (1-3k-c)(k+\Delta), \text{ if } \alpha > 5k-\Delta-(1-c) \end{cases} \tag{6.2}$$

Clearly, when the efficiency gains are high enough (i.e. $\alpha > 5k-\Delta-(1-c)$), the merged firm is also led to employ all of its capacity. However, if the divestiture exceeds the threshold above mentioned, regardless of the level of merger synergies, the outsider will never operate to full capacity. Thus, for $\Delta > (1-c)-4k$, profits write

$$\Pi^M(\Delta;\alpha) = \left(\frac{1+2\alpha-c-2k+\Delta}{2}\right)(2k-\Delta) \tag{6.3}$$

$$\text{and } \Pi^o(\Delta;\alpha) = \left(\frac{1-c-2k+\Delta}{2}\right)^2 \tag{6.4}$$

and in this case the market price will increase.

At stage four, as far as the outsider is concerned, the decision to accept to take over the divested assets depends on his maximum willingness to pay for them, equal to $\Pi^o(\Delta;\alpha) - \Pi$. We denote by P the price of divestitures proposed by the merged entity and observed by the CA. The outsider accepts the divested assets iff $\Pi^o(\Delta;\alpha) - P \geq \Pi$.

At stage three, the insiders make a take-it-or-leave-it offer to the outsider, therefore they set a price equal to the outsider's maximum willingness to pay: $P = \Pi^o(\Delta;\alpha) - \Pi$. The insiders agree to divest iff $\Pi^M(\Delta;\alpha) + P \geq 2\Pi$.

At the second stage, given that the CA observes the type of the merger submitted for approval, it makes its decision based on the following programme:

$$\max_{\Delta \geq 0} W(\Delta;\alpha) \tag{S}$$

$$\text{s.t.} \begin{cases} CS(\Delta;\alpha) \geq CS_0 \\ \Pi^M(\Delta;\alpha) + P \geq 2\Pi \\ \Pi^o(\Delta;\alpha) - \Pi = P \end{cases}$$

where CS_0 stands for the Consumers' Surplus level before merger. With symmetric information, the following result obtains:

Lemma 6.1

Let $\Delta^{FB}(\alpha)$ *be the solution of the programme (S), defined as follows:*

(i) For $k \in \left(\frac{2(1-c)}{9}, \frac{2-c}{9}\right)$, *there exists a threshold* $\widehat{\alpha} = 9k - 2(1-c)$, $\widehat{\alpha} \in [0, c]$, *such that:*

- for any $\alpha \geq \widehat{\alpha}$, *the merger is accepted with divestiture* $\Delta^{FB}(\alpha)$, *where* $\Delta^{FB}(\alpha) = \max(0, 5k - \alpha - (1-c))$; *also,* $\Delta^{FB}(\underline{\alpha}) < \Delta^{FB}(\overline{\alpha})$.

- for any $\alpha < \widehat{\alpha}$, *the merger is rejected.*

(ii) For $k \leq \frac{2(1-c)}{9}$, *all mergers are accepted with* $\Delta^{FB}(\alpha) = \max(0, 5k - \alpha - (1-c))$

(iii) For $k \geq \frac{2-c}{9}$, *all mergers are rejected.*

Whenever the divestitures $\Delta^{FB}(\underline{\alpha})$ *and* $\Delta^{FB}(\overline{\alpha})$ *exist, the assets are transferred to the outsider at prices equal to* $\underline{P}^{FB} = (P(3k) - c) \times \Delta^{FB}(\underline{\alpha})$ *and* $\overline{P}^{FB} = (P(3k) - c) \times \Delta^{FB}(\overline{\alpha})$ *respectively.*

See proof in the final section of the chapter.

Basically, the First Best asset transfer, denoted $\Delta^{FB}(\alpha)$, is the lowest positive asset transfer that ensures production at full capacity on behalf of both industry firms. Given that the market price increases whenever firms hold slack capacity, successful remedies in our context are necessarily those that induce firms to produce up to their full capacity. However, since total industry capacity is fixed, firms can never produce more than they did before merger. (Consequently, in our framework, maximizing consumers' surplus after merger and keeping it constant are equivalent.) On the other hand, among all the asset transfers inducing production to full capacity, the lowest represents the solution to the above programme, because it yields the highest industry profit. Indeed, all divestitures ensuring production to full capacity yield the same total output, but since the outsider operates with a higher marginal cost, industry profit is highest for the lowest asset transfer. In other words, the latter maximizes total surplus under the constraint of constant consumers' surplus. Incidentally, this is in accordance with the merger control guidelines and practice, since merger remedies are to be the slightest modification possible that is able to restore market competition. Finally, the positivity constraint of this programme simply states that whenever there exists no such divestiture, the merger is rejected.

This lemma shows that our mechanism replicates the outcome of CAs' behavior to the

extent that merger control decisions obey threshold criteria. Here, whenever the notified merger does not generate enough cost savings, the CA rejects it. Henceforth we shall only consider $k \in \left(\frac{2(1-c)}{9}, \frac{2-c}{9}\right)$, so as to deal with an interesting case. Indeed, if the industry capacity is large enough, a duopoly is never induced to produce at full capacity even if the cost of M is zero, whereas if the capacity is low enough, a duopoly always produces at full capacity, even without efficiency gains. In other words, we leave aside cases ii) and iii), and focus only on the more interesting and relevant case i).

Moreover, if firms anticipate the CA's decision making process, only efficiently enough mergers will be proposed, and therefore all submitted mergers shall be accepted. This is a self selection effect. In turn, if $\underline{\alpha} < \widehat{\alpha}$, no merger is submitted. Henceforth we shall consider only the case where $\underline{\alpha} > \widehat{\alpha}$.

More importantly, the required transfer is higher for the less efficient merger. The reason is quite simple: in this model with fixed total capacity, for the price to be constant, firms need to produce to their full capacity. But the more efficiency gains it generates, the more capacity will employ the merged entity. Therefore, more efficient insiders hold less slack capacity, so the price increase will be lower for a more efficient merger, and the corresponding necessary divestiture as well. This conforms with the proportionality principle advocated by competition policy practitioners, and justifies the fact that the average sale price of divested assets is actually constant, since $\frac{P^{FB}}{\Delta^{FB}(\underline{\alpha})} = \frac{\overline{P}^{FB}}{\Delta^{FB}(\overline{\alpha})}$. Nevertheless, such a proportionality principle is subject to an implementation problem if efficiency gains captured here by the parameter α are not observed by the CA. We deal with this asymmetric information problem in the next section.

6.3.3 Optimal divestitures with asymmetric information: a regulated sale price mechanism

The asymmetric information game is basically the same as before, but takes into account the changes due to the inobservability of the merger type:

In the first stage, the merging firms learn their efficiency level and submit a merger proposal to the CA. The parameter α is now private information of the merging firms, and the latter may or may not report it truthfully.

In the second stage, the CA evaluates the consequences of the merger taking into account its own merger control objective. It proposes a divestiture contract accordingly, if such a contract exists; if not, it rejects the merger. The divestiture contract will contain the amount of assets to be divested, Δ, and the corresponding sale price P.

In the third stage, the insiders accept or reject the divestiture. If they accept, assets will be transferred to the outsider at the price P determined by the CA.

In the fourth stage, the outsider, having observed the insiders' choice to accept or not the divestiture contract, decides whether to take over or not the divested assets.

In the fifth stage, conditional on the divestiture contract being accepted, the Cournot market equilibrium is determined taking into account the amount of asset transfer required by the CA. The merger is abandoned whenever one of the parties rejects the contract.

The CA and the outsider have a common prior on the merger's types (ρ and $1-\rho$), but at stage four the outsider observes the menu of contracts proposed by the CA, as well as the contract chosen by the merged entity, and thus revises its prior beliefs.

According to the revelation principle, we restrict to truthful direct revelation mechanisms, and look for a separating perfect Bayesian equilibrium of the game.

To start with, when information is asymmetric and the only revelation instrument employed is the asset transfer, the CA is no longer able to make the insiders reveal truthfully their efficiency level, i.e. their type, since they always choose the lowest level of divestitures which is proposed. Indeed, should the CA propose the former First Best levels of divestiture $\Delta^{FB}(\underline{\alpha})$ and $\Delta^{FB}(\overline{\alpha})$, associated with the previous symmetric-information prices, i.e. equal to the outsider's willingness to pay, we can show that the high-cost merged firm has incentives to choose the low asset transfer destined to the low-cost merged entity. Explicitly, the following holds (see proof in the final section):

$$\Pi^M(\Delta^{FB}(\overline{\alpha});\overline{\alpha}) + \underbrace{\Pi^o(\Delta^{FB}(\overline{\alpha});\overline{\alpha}) - \Pi}_{=\overline{P}^{FB}} < \Pi^M(\Delta^{FB}(\underline{\alpha});\overline{\alpha}) + \underbrace{\Pi^o(\Delta^{FB}(\underline{\alpha});\underline{\alpha}) - \Pi}_{=\underline{P}^{FB}} \quad (6.5)$$

In other words, if the first best levels of divestitures are required, mimicking is more profitable than truth-telling for the less efficient type. Indeed, when the optimal symmetrical information divestitures are sold for a price equal to the outsider's willingness to pay

($\overline{P}^{FB}$ or $\underline{P}^{FB}$ respectively), the less efficient merged entity prefers the lower asset transfer, which will enable it to hold spare capacity and thus increase its profit through the price raise. As a result, in order to induce truthful revelation, a second instrument is necessary.

We propose here to use the regulation of the monetary transfer between the insiders and the outsider that accompanies the asset takeover. In case this idea should trigger the critique that the CA behaves as a sheer market regulator, we claim that it is worth analyzing it for several reasons. Firstly, it allows us to test its theoretical relevance for the merger control. Secondly, because the frontier between pure regulation and merger control has already been blurred by the very use of structural divestitures, meant to modify the very market structure. After all, "introducing the possibility of remedies ... puts the merger control office in a position close to that of an industry specific regulator" (Rey (2003, p.130)).

The incentive contract determined by the CA will thus contain a given sale price P for an amount of divested assets Δ. Two Incentive Constraints (IC) are added to the programme of the CA in order to induce revelation of information. Hence, the programme of the CA writes:

$$\max_{\substack{\{(\underline{\Delta},\underline{P}),(\overline{\Delta},\overline{P})\} \\ \underline{\Delta}\geq 0,\overline{\Delta}\geq 0}} \rho W\left(\underline{\Delta};\underline{\alpha}\right)+\left(1-\rho\right)W\left(\overline{\Delta};\overline{\alpha}\right) \qquad \text{(AS)}$$

$$\text{s.t.}\begin{cases} CS\left(\underline{\Delta};\underline{\alpha}\right)=CS\left(\overline{\Delta};\overline{\alpha}\right)=CS_0 \\ \Pi^M\left(\underline{\Delta};\underline{\alpha}\right)+\underline{P}\geq\Pi^M\left(\overline{\Delta};\underline{\alpha}\right)+\overline{P} \\ \Pi^M\left(\overline{\Delta};\overline{\alpha}\right)+\overline{P}\geq\Pi^M\left(\underline{\Delta};\overline{\alpha}\right)+\underline{P} \\ \Pi^M\left(\underline{\Delta};\underline{\alpha}\right)+\underline{P}\geq 2\Pi \\ \Pi^M\left(\overline{\Delta};\overline{\alpha}\right)+\overline{P}\geq 2\Pi \\ \Pi^o\left(\underline{\Delta};\underline{\alpha}\right)-\underline{P}\geq\Pi \\ \Pi^o\left(\overline{\Delta};\overline{\alpha}\right)-\overline{P}\geq\Pi \end{cases}$$

where the contracts $(\underline{\Delta};\underline{P})$ and $\left(\overline{\Delta};\overline{P}\right)$ are destined for types $\underline{\alpha}$ and $\overline{\alpha}$ respectively.

Note that unlike a standard screening programme, there is no direct transfer between the 'agent' and the 'principal'. Instead, the CA fixes the monetary transfer between the agent and a third party, the outsider, and uses it as an incentive device. The lump-sum transfer between firms does not affect total industry profit, and is different from the

informal suggestion of Röller et al. (2001) to introduce an explicit licence to merge, to the extent that in our model the monetary transfer does not benefit directly the CA, so we actually avoid the direct implication of the CA in the merger process as an explicit regulator.

Note equally that since the contract we look for induces information revelation, i.e. separation of types, in equilibrium the priors of the outsider necessarily coincide with its revised beliefs. As in the symmetric information configuration, CA implicitly uses a supplementary choice variable to solve the screening problem, namely the possibility of shut-down (i.e. refuse the merger of the less efficient type), hence the positivity constraints on the asset transfers. Finally, the equality constraints on Consumers' Surplus as well as the participation constraints highlight the three-party negotiation. Indeed, the additional instrument we propose to screen mergers, the sale price of the divested assets, is merely a lump-transfer between the outsider and the insiders, therefore it stands for a particular distribution of the total industry profit. To achieve screening, the contracts proposed by the CA need to reconcile the often conflicting objectives of the insiders and the outsider, so as to ensure the industry firms' participation. In other words, the above programme is actually designed to make the parties involved agree on an incentive-compatible sharing of their total profit.

Before presenting and characterizing the optimal contracts we give the following lemma:

Lemma 6.2

For any $\underline{\Delta} < \overline{\Delta}$, $\Pi^M\left(\underline{\Delta};\underline{\alpha}\right) - \Pi^M\left(\overline{\Delta};\underline{\alpha}\right) > \Pi^M\left(\underline{\Delta};\overline{\alpha}\right) - \Pi^M\left(\overline{\Delta};\overline{\alpha}\right)$.

See proof in the final section.

This inequality stands for a standard single crossing condition. It states that the efficient merged firm benefits more from a low asset divestiture than the inefficient one. In other words, the efficient merged firm attaches more value to capacity than the inefficient one. The intuition goes as follows: following merger and the ensuing increase in capacity, the efficient insiders are always able to produce the same quantity as the inefficient ones, and can thus guarantee themselves the same revenue. Yet, thanks to the synergy cost reduction, their profit is actually higher, hence their willingness to receive w.r.t. the mon-

etary payment of a given divestiture is lower. As in any standard principal-agent model, this lemma makes room for screening. We can therefore derive the optimal contracts summarized in the following proposition:

Proposition 6.1

Denote $(\underline{\Delta}, \underline{P})$, $\left(\overline{\Delta}, \overline{P}\right)$ *the divestiture contracts proposed with asymmetric information, solution of the programme (AS); the following hold:*

(i) No shut-down

When $\overline{\alpha} > \widehat{\alpha}$, *then* $\underline{\Delta} = \Delta^{FB}(\underline{\alpha})$ *and* $\overline{\Delta} = \Delta^{FB}(\overline{\alpha})$. *Prices are* $\overline{P} = \Pi^{o}(\overline{\Delta}; \overline{\alpha}) - \Pi$ *and* $\underline{P} = \overline{P} - \Pi^{M}(\underline{\Delta}; \underline{\alpha}) + \Pi^{M}\left(\overline{\Delta}; \underline{\alpha}\right)$. *Moreover, there exists a threshold* $\widetilde{\alpha}$ *such that for* $\underline{\alpha} > \widetilde{\alpha}$, $\underline{P} < 0$.

(ii) Shut-down of less efficient type

When $\overline{\alpha} < \widehat{\alpha}$, *type* $\overline{\alpha}$ *merger is rejected by offering a single contract:* $\underline{\Delta} = \Delta^{FB}(\underline{\alpha})$ *and* $\underline{P} = 2\Pi - \Pi^{M}(\underline{\Delta}; \overline{\alpha})$

See proof in the final section.

The optimal contracts have two main characteristics. First, there is no distortion of asset divestitures and the merger clearance decision is unchanged as compared with the case of symmetric information. Second, the price of the low divestiture is distorted downwards, whereas the price of the high divestiture is not distorted at all (meaning it still equals the outsider's willingness to pay), so that the average divestiture price increases now with the level of divestiture. To sum up, we obtain no distortion at all in terms of asset transfers, and distortion 'at the top' for the monetary transfers.

The intuition behind the design of these contracts proceeds in two steps.

First of all, we have previously emphasized that the CA must distort asset prices and possibly divestiture levels so as to obtain separation of types. Otherwise, both types choose the low level of divestiture. Note however that since the asset price is a lump-sum transfer between firms without impact on the CA's objective, the CA can distort prices at no cost.

Secondly, it remains to show that price distortion alone is sufficient to lead both firms to choose the optimal levels of divestiture disclosed in Lemma 6.1. For that purpose the CA must lower the price of the low level of divestitures so as to deter the inefficient

firm from choosing such a contract. According to Lemma 6.2, a given divestiture is more distorting for the efficient merged firm than for the inefficient one, and thus the willingness to receive for the First Best asset transfer $\underline{\Delta}^{FB}$ is lower for the efficient merged entity. Hence, to induce the inefficient merged entity to give up the low asset transfer $\underline{\Delta}^{FB}$, the corresponding price needs to be lower than the outsider's willingness to pay. To sum up, it is enough to keep the price of the high First Best divestiture equal to the outsider's willingness to pay, and in turn to set for the low First Best divestiture a price inferior to the outsider's willingness to pay.

Moreover, in a particular configuration, the asset price can be negative, so that the CA would require the efficient merged entity to subsidize the outsider. Specifically, if the efficient firm has very substantial cost savings, the optimal level of divestiture required to the efficient firm is so low, that in order to prevent the inefficient merged firm from choosing it, the corresponding distortion on the sale price will make it negative.

A low price of divested assets was often interpreted as a signal of failure of the divestiture process - the European Commission's Merger Remedies Study, October 2005 (p.103), recalls that "remedies were less effective in at least three divestiture cases where the purchaser had acquired the divested business for free, or at a negative price"[22]. We claim however that a more efficient merger can signal itself as such by accepting a divestiture contract combining a low average asset price and a low quantity of assets divested. In contrast, an inefficient merged firm will reveal itself as such by accepting to divest a large quantity of assets for a high average price. The underlying intuition is that in the present model, the inefficient entity owns more slack capacity and values assets less than the efficient one. This is the reason why the inefficient insiders agree to divest a larger quantity of assets in exchange for a higher price, while the efficient ones accept a low sale price so as to divest less assets.

Still, the CA might have to reject the less efficient merger due to the absence of optimal divestiture, i.e. when $\overline{\alpha} < \widehat{\alpha}$. However, with asymmetric information and no price distortion, both types of insiders will submit their merger. Therefore, to extract

[22] See also Farrell (2003), or the Antitrust Division Policy Guide to Merger Remedies, by the US Department of Justice, October 2004.

information, the CA will distort downwards the price for the low divestiture, so as to incite the submission of the highly efficient merger only. Point (ii) of our Proposition 6.1 actually gives the value of $\underline{P}$ that contradicts the participation constraint of $\overline{\alpha}$, while still ensuring that of $\underline{\alpha}$. For this price, only the efficient merger will be submitted.

Our proposition suggests that regulating the sale price of divested assets enables the implementation of a kind of licence to merge. The way the merged entity will pay to be allowed to merge depends on its level of efficiency. Indeed, the divestiture imposes a cost to the merged entity, which will have to give up some of its assets. Still, the above-mentioned licence is not the amount of assets to divest, but actually the combination of a divestiture and its sale price. The inefficient merged firm essentially 'pays' by giving up more assets while still being handsomely paid in return, whereas the efficient one 'pays' by foregoing part of the monetary transfer from the outsider (and possibly the whole) for the lower divestiture made. Hence, one way to interpret our result is that a divestiture trustee appointed by the CA might tell an efficient merger proposal from an inefficient one using such a non linear tariff for asset divestitures[23].

Note that this mechanism bears no risk of inefficient or distorting lobbying activities on behalf of the parties involved. In particular, the outsider will not oppose the more efficient merger, because the more efficient insiders will transfer less assets at a depreciated price, and the profit sharing is favourable to the outsider, who pays less than his maximum willingness to pay. In short, our mechanism is designed to make all three parties agree on an incentive-compatible distribution of the industry profit. In other words, by making use of a three-party incentive-compatible negotiation, the CA can make sure that no lobbying activities occur.

Within the debate concerning the frontier between competition policy and regulation, our proposition is meant to draw attention to the best instruments that should be used to address the anticompetitive effects of merger. We argue that while price distortion is considered as highly interventionist and prohibited in the typical view of competition

[23] To put it short, the divestiture trustee might ask the merged entity the following question: "Would you rather rather transfer a larger divestiture package to obtain a high price in return from the purchaser, or are you willing to forego the monetary payment but divest less?". According to our model, the less efficient merged entity will agree to the former, while the more efficient merged entity will prefer the latter.

policy, in a merger control context the most distorting tool is more likely to be the asset transfer, rather than a lump-sum monetary transfer between industry firms. Indeed, whereas the monetary transfer does not affect market behaviour of firms, the amount of divested assets has a direct impact on firms' production decisions. As a result, in order to induce firms to reveal efficiency gains, the use of monetary transfer appears less interventionist than the transfer of physical assets.

Further discussion

We address next some of the possible questions raised by our proposition of additional instrument within the revelation contract menu. More precisely, we are going to further discuss two points in particular, namely the wide range of sale prices we allow for in our mechanism, and the possibility to use a monetary transfer to the central budget instead of interfering with the divestiture sale price.

To start with, recall that despite the information asymmetry, types are perfectly screened in our model, and only divestiture sale prices get distorted. To be precise, the distortion only concerns the sale price for the efficient type's divestiture. Intuitively, this is so because it is the inefficient type who has incentives to mimic, so the menu contract basically distorts the price received by the 'honest' efficient type, so as to make the corresponding low divestiture less desirable to the mimicking type. Hence one might realize that complete distortion, i.e. also affecting divestiture levels, is likely to be necessary if a positivity constraint were imposed on the asset sale prices. Actually, we show in the final section by means of a very simple intuitive reasoning that the outcome would be instead the shutdown of the inefficient merger, through the unique divestiture contract given in Proposition 6.1. This is due to the fact that the necessary distortion on asset transfers would fail to maintain constant the market price, as a result of which the CA would prefer to prevent inefficient mergers from being submitted, rather than not being able to fully remedy them afterwards.

This might be different however if the demanding constant Consumer Surplus constraint were relaxed. Intuitively, (see again the final section for an outline of the reasoning) even if the additional screening instrument is no longer the divestiture sale price, but instead a monetary payment (a tax, basically) to the budget, the qualitative results are

the same. One would have to completely give up the constant market price requirement in order to obtain substantially different results. But doing so, i.e. modeling a CA that maximizes a sum of Consumer Surplus and collected tax, subject only to incentive and participation constraints, would require first of all supplementary assumptions ensuring the concavity of this objective function w.r.t. the divestiture level. The result would then be predictable based on a standard principal-agent framework (the mechanism would no longer involve a three-party negotiation actually), and it would involve a downward tax distortion for the efficient type and an upwards asset transfer distortion for the inefficient type w.r.t. the situation where total welfare is maximized with symmetric information.

6.4 Conclusion

This chapter aims to contribute to the economic analysis of merger remedies. We propose a revelation mechanism allowing the design of optimal merger divestitures when information is asymmetric between firms and the CA w.r.t. the synergy generated by the merger. Our revelation mechanism replicates the typical behavior of a CA, namely decision making based on thresholds of announced efficiencies. In our framework, shut-down of the least efficient type is possible. Basically, mergers will only be accepted if they generate enough synergies, which is what the merger control practically aims at.

Our results show that a contract menu combining the divestiture with its sale price is a powerful screening device, leading to perfect information revelation, in addition to the complete competitive relief and the lowest industry profit distortion.

We acknowledge of course the modelling of a CA actively modifying the market structure, but then any structural merger remedy is precisely meant to do this. Taking into account the reluctance of competition authorities to actually employ this instrument for the screening of merger projects, we can nevertheless insist on the ability of the price of divested assets to contribute to signalling on behalf of merging partners the merger efficiency gains.

6.5 Proofs

Post-merger Cournot equilibrium. Successful Remedies:

These are the transfers for which both firms produce up to their post-merger capacity: for M, $2k-\Delta$, and for o, $k+\Delta$. Checking that the Best Reply function yield in equilibrium precisely the post-merger capacities allows us to compute the limits of the relevant range for the divestiture:

for M: $BR^M(q^o = k+\Delta) = \frac{1+\alpha-c-(k+\Delta)}{2} \geq 2k-\Delta \Leftrightarrow \Delta \geq 5k-\alpha-(1-c) = \Delta_1$

for o: $BR^o(q^M = 2k-\Delta) = \frac{1-c-(2k-\Delta)}{2} \geq k+\Delta \Leftrightarrow \Delta \leq (1-c)-4k = \Delta_2$

It is straightforward to check that for $\Delta < \Delta_1$, the outsider produces up to its full capacity, but the merged firm holds slack capacity, whereas for $\Delta > \Delta_2$ the reverse is true. Note that $\Delta_1 > 0$ as long as $\alpha \leq 5k-(1-c)$, a necessary condition being $k \geq \frac{1-c}{5}$ so as to have positive cost savings. ■

Proof of Lemma 6.1. As seen before, successful remedies belong to $[\Delta_1, \Delta_2]$, with $\Delta_1 = 5k-\alpha-(1-c)$. The First Best level of divestiture is actually Δ_1: we show it next to be the lowest positive asset transfer that satisfies the objective of maximizing total surplus under the binding constraint on the consumers' surplus. Indeed, it suffices to show that industry profits are decreasing with the amount of divestiture when the latter induces production to full capacity in order to select the lowest divestiture as the $\Delta^{FB}(\alpha) = 5k-\alpha-(1-c)$; and since $\Pi^M+\Pi^o = (1-3k-c+\alpha)(2k-\Delta)+(1-3k-c)(k+\Delta)$, it is straightforward that $\frac{\partial}{\partial\Delta}\left(\Pi^M+\Pi^o\right) = -\alpha < 0$, q.e.d.

The existence of $\Delta^{FB}(\alpha)$ is ensured as long as the interval $[\Delta_1, \Delta_2]$ exists and is well defined. Define $\widehat{\alpha}$ as the threshold value of cost savings for which $\Delta_1 = \Delta_2$: $\widehat{\alpha} = 9k-2(1-c)$. The threshold $\widehat{\alpha}$ corresponds to the shut-down limit, and is positive provided that $k \geq \frac{2(1-c)}{9}$. Therefore, whenever $\alpha < \widehat{\alpha}$, we have $\Delta_1 > \Delta_2$, so the CA rejects all mergers, since there is no transfer Δ for which firms produce both to full capacity. In turn, for $\alpha \geq \widehat{\alpha}$, $\Delta^{FB}(\alpha) = 5k-\alpha-(1-c)$ and since $\underline{\alpha} > \overline{\alpha}$ we obtain directly $\Delta^{FB}(\underline{\alpha}) < \Delta^{FB}(\overline{\alpha})$. In case $\widehat{\alpha}$ is zero, case (ii), for all mergers there exists a positive transfer such that the CA's objective is fulfilled. In the last case (case (iii)), the shutdown range covers the whole interval, so there are no transfers that can make both firms operate to full capacity.

Finally, since assets are divested to the outsider for a price equal to its willingness to pay, corresponding prices are given by: $\underline{P}^{FB} = \Pi^o(\Delta^{FB}(\underline{\alpha});\underline{\alpha}) - \Pi = (P(3k) - c)\Delta^{FB}(\underline{\alpha})$ and $\overline{P}^{FB} = \Pi^o(\Delta^{FB}(\overline{\alpha});\overline{\alpha}) - \Pi = (P(3k) - c)\Delta^{FB}(\overline{\alpha})$. ■

Proof - incentive to mimic.

$$\Pi^M(\Delta^{FB}(\overline{\alpha});\overline{\alpha}) + \underbrace{\Pi^o(\Delta^{FB}(\overline{\alpha});\overline{\alpha}) - \Pi}_{=\overline{P}^{FB}} \leq \Pi^M(\Delta^{FB}(\underline{\alpha});\overline{\alpha}) + \underbrace{\Pi^o(\Delta^{FB}(\underline{\alpha});\underline{\alpha}) - \Pi}_{=\underline{P}^{FB}}$$

$\Leftrightarrow [P(3k) - c + \overline{\alpha}] \cdot \left(2k - \Delta^{FB}(\overline{\alpha})\right) + [P(3k) - c] \cdot \left(k + \Delta^{FB}(\overline{\alpha})\right) <$
$\left[P(k + \Delta^{FB}(\underline{\alpha}) + BR^M_{\overline{\alpha}}(k + \Delta^{FB}(\underline{\alpha}))) - c + \overline{\alpha}\right] \cdot BR^M_{\overline{\alpha}}(k + \Delta^{FB}(\underline{\alpha}))$
$- [P(3k) - c] \cdot \left(k + \Delta^{FB}(\underline{\alpha})\right)$
$\Leftrightarrow [P(3k) - c] \cdot \left(\Delta^{FB}(\overline{\alpha}) - \Delta^{FB}(\underline{\alpha})\right) <$
$\left[P(k + \Delta^{FB}(\underline{\alpha}) + BR^M_{\overline{\alpha}}(k + \Delta^{FB}(\underline{\alpha}))) - c + \overline{\alpha}\right] \cdot BR^M_{\overline{\alpha}}(k + \Delta^{FB}(\underline{\alpha}))$
$- [P(3k) - c + \overline{\alpha}] \cdot \left(2k - \Delta^{FB}(\overline{\alpha})\right)$
$\Leftrightarrow (1 - 3k - c) \cdot (\underline{\alpha} - \overline{\alpha}) < \left(1 - 3k - c + \frac{\underline{\alpha}+\overline{\alpha}}{2}\right)^2 - (1 - 3k - c + \overline{\alpha})^2$
$\Leftrightarrow \frac{1}{4}(\overline{\alpha} - \underline{\alpha}) \cdot (\underline{\alpha} + 3\overline{\alpha}) < 0$ which is true since $0 \leq \overline{\alpha} < \underline{\alpha}$ ■

Proof of Lemma 6.2. A necessary condition for the two incentives constraints to hold is $\Pi^M(\underline{\Delta};\underline{\alpha}) - \Pi^M\left(\overline{\Delta};\underline{\alpha}\right) > \Pi^M(\underline{\Delta};\overline{\alpha}) - \Pi^M\left(\overline{\Delta};\overline{\alpha}\right)$. We prove this below.

To start with, the profit of the merged firm writes generally as follows:
$\Pi^M(\Delta;\alpha) = \left[P(k + \Delta + BR^M(k + \Delta)) - c + \alpha\right] \cdot BR^M(k + \Delta)$
where $BR^M(k + \Delta) = \min\left(\frac{1+\alpha-c-(k+\Delta)}{2}, 2k - \Delta\right)$
We show next that $\frac{\partial^2 \Pi^M(\Delta;\alpha)}{\partial \Delta \partial \alpha} < 0$.

Starting from the above profit's expression, basically two cases are possible: given the asset transfer Δ, the merged entity M either produces to full capacity or not.

If M produces to full capacity, its profit writes $\Pi^M(\Delta;\alpha) = \left(\frac{1+\alpha-c-(k+\Delta)}{2}\right)^2$ (see the post-merger Cournot equilibrium details in the beginning of this section). In this case, $\frac{\partial \Pi^M(\Delta;\alpha)}{\partial \Delta} = 2\left(\frac{1+\alpha-c-(k+\Delta)}{2}\right) \cdot \left(-\frac{1}{2}\right) < 0$, whereas $\frac{\partial^2 \Pi^M(\Delta;\alpha)}{\partial \Delta \partial \alpha} = \left(-\frac{1}{2}\right) < 0$, q.e.d.

If M does not produce to full capacity, then its profit is $\Pi^M(\Delta;\alpha) = (1 - 3k - c + \alpha)(2k - \Delta)$. In this case, $\frac{\partial \Pi^M(\Delta;\alpha)}{\partial \Delta} = -(1 - 3k - c + \alpha) < 0$, and $\frac{\partial^2 \Pi^M(\Delta;\alpha)}{\partial \Delta \partial \alpha} = -\alpha < 0$, q.e.d.

Conclusion: since $\underline{\alpha} > \overline{\alpha}$, the cross derivative $\frac{\partial^2 \Pi^M(\Delta;\alpha)}{\partial \Delta \partial \alpha} < 0$ yields equivalently $\frac{\partial}{\partial \alpha}\left(\frac{\partial \Pi^M(\Delta;\alpha)}{\partial \Delta}\right) < 0 \Leftrightarrow \frac{\partial \Pi^M(\Delta;\overline{\alpha})}{\partial \Delta} > \frac{\partial \Pi^M(\Delta;\underline{\alpha})}{\partial \Delta}$

$\Leftrightarrow \frac{\partial}{\partial \Delta}\left(\Pi^M(\Delta;\overline{\alpha}) - \Pi^M(\Delta;\underline{\alpha})\right) > 0, \forall \Delta$

$\Leftrightarrow$ for any $\underline{\Delta} < \overline{\Delta}$, $\left(\Pi^M(\underline{\Delta};\overline{\alpha}) - \Pi^M(\underline{\Delta};\underline{\alpha})\right) < \left(\Pi^M(\overline{\Delta};\overline{\alpha}) - \Pi^M(\overline{\Delta};\underline{\alpha})\right)$

$\Leftrightarrow \Pi^M(\underline{\Delta};\overline{\alpha}) - \Pi^M(\overline{\Delta};\overline{\alpha}) < \Pi^M(\underline{\Delta};\underline{\alpha}) - \Pi^M(\overline{\Delta};\underline{\alpha}), \forall\ \underline{\Delta} \neq \overline{\Delta}$, q.e.d. ■

Proof of Proposition 6.1.

- No shut-down

For $\overline{P} = \Pi^o(\overline{\Delta};\overline{\alpha}) - \Pi$ and $\underline{P} = \Pi^o(\underline{\Delta};\underline{\alpha}) - \Pi$, both firms prefer the contract $(\underline{\Delta}, \underline{P})$, since the following inequality holds for the inefficient type:

$$\Pi^M(\overline{\Delta};\overline{\alpha}) + \Pi^o(\overline{\Delta};\overline{\alpha}) < \Pi^M(\underline{\Delta};\overline{\alpha}) + \Pi^o(\underline{\Delta};\underline{\alpha})$$

In turn, if $\underline{P} = 2\Pi - \Pi^M(\underline{\Delta};\underline{\alpha})$, then $\Pi^M(\underline{\Delta};\underline{\alpha}) + \underline{P} < \Pi^M(\overline{\Delta};\underline{\alpha}) + \overline{P}$

so both firms prefer the contract $(\overline{\Delta}, \overline{P})$.

By continuity of $\underline{P}$, there exist $\underline{P}$ and $\overline{P} = \Pi^o(\overline{\Delta};\overline{\alpha}) - \Pi$ with

$$\Pi^o(\underline{\Delta};\underline{\alpha}) - \Pi \geq \underline{P} > 2\Pi - \Pi^M(\underline{\Delta};\underline{\alpha})$$
$$\text{such that } \Pi^M(\underline{\Delta};\underline{\alpha}) - \Pi^M(\overline{\Delta};\underline{\alpha}) = \overline{P} - \underline{P}$$

This latter condition ensures that $\overline{P} - \underline{P} > \Pi^M(\underline{\Delta};\overline{\alpha}) - \Pi^M(\overline{\Delta};\overline{\alpha})$, i.e. separation of types, thanks to the single-crossing condition (see Lemma 2).

We show next there exists $\widetilde{\alpha}$ such that for $\underline{\alpha} > \widetilde{\alpha}$, $\underline{P} < 0$

First of all, note that for $\underline{\Delta} = 0$, $\underline{P} < 0$ necessarily, because:

$$\begin{aligned}
\underline{P} &= \overline{P} - \left(\Pi^M(\underline{\Delta};\underline{\alpha}) - \Pi^M(\overline{\Delta};\underline{\alpha})\right) \\
&= \Pi^o(\overline{\Delta};\overline{\alpha}) - \Pi - \left(\Pi^M(\underline{\Delta};\underline{\alpha}) - \Pi^M(\overline{\Delta};\underline{\alpha})\right) \\
&= (P(3k) - c) \cdot \left(k + \overline{\Delta}\right) - (P(3k) - c) \cdot k \\
&\quad - \left((P(3k) - c + \underline{\alpha}) \cdot (2k - \underline{\Delta}) - (P(3k) - c + \underline{\alpha}) \cdot \left(2k - \overline{\Delta}\right)\right) \\
&= (P(3k) - c) \cdot \overline{\Delta} - (P(3k) - c + \underline{\alpha})\left(\overline{\Delta} - \underline{\Delta}\right)
\end{aligned}$$

$\Rightarrow$ for $\underline{\Delta} = 0$, this yields $(P(3k) - c) \cdot \overline{\Delta} - (P(3k) - c + \underline{\alpha})\,\overline{\Delta} < 0$

Moreover, $\underline{\Delta} = 0 \Leftrightarrow 5k - \underline{\alpha} - (1-c) = 0 \Leftrightarrow \underline{\alpha} = 5k - (1-c)$

To sum up, for $\underline{\alpha} = 5k - (1-c)$ (which by the way is $> \widehat{\alpha}$), $\underline{P} < 0$

But, for $\underline{\alpha} = \overline{\alpha}$, $\underline{P} = \overline{P}$, thus $\underline{P} > 0$

Therefore, by continuity and monotonicity[24] of $\underline{P}$, there exists a $\widetilde{\alpha} > \widehat{\alpha}$ such that for $\underline{\alpha} > \widetilde{\alpha}, \underline{P} < 0$

Last but not least, we can show that a sufficient condition for this threshold $\widetilde{\alpha}$ to be $< c$ is to have $k < \frac{1}{5}$, which is compatible with our condition for positive cost savings, namely $k \geq \frac{1-c}{5}$.

- Shut-down of less efficient merger

  When $\overline{\alpha} < \widehat{\alpha}$, the optimal response from the CA is to reject the $\overline{\alpha}$, simply because it is the only way to keep the price constant - see Lemma 6.1, which shows that when there is no transfer Δ that can keep the price constant, the CA rejects the merger. To prevent therefore the submission of the $\overline{\alpha}$ merger, it is enough to set $\underline{P} = 2\Pi - \Pi^M(\underline{\Delta}; \overline{\alpha})$, which violates the participation constraint of the $\overline{\alpha}$ type.

■

Further discussion.

- Positivity constraints on divestiture sale prices

The necessary condition for information revelation is for both incentive constraints to hold simultaneously:

$\Pi^M(\underline{\Delta}; \underline{\alpha}) - \Pi^M(\overline{\Delta}; \underline{\alpha}) \geq \overline{P} - \underline{P} \geq \Pi^M(\underline{\Delta}; \overline{\alpha}) - \Pi^M(\overline{\Delta}; \overline{\alpha})$

Adding positivity constraints on $\underline{P}$ and $\overline{P}$ to the asymmetric information programme would raise a problem only for certain levels of efficiencies. Actually, such a constraint will not concern $\overline{P}$, but only be relevant for the efficiency levels $\underline{\alpha} > \widetilde{\alpha}$ for which $\underline{P} < 0$. The point is that by imposing $\underline{P} > 0$ for these high efficiency levels, the price difference $\overline{P} - \underline{P}$ will become equal to a fixed value. This will eventually prevent the relevant $\overline{\alpha}-$type incentive constraint from being satisfied: $\overline{P} - \underline{P} \geq \Pi^M(\underline{\Delta}; \overline{\alpha}) - \Pi^M(\overline{\Delta}; \overline{\alpha})$, since

[24] It is straightforward to show that $\underline{P}$ is decreasing with $\underline{\alpha}$, given its expression computed above: $\underline{P} = (P(3k) - c) \cdot \overline{\Delta} - (P(3k) - c + \underline{\alpha})(\overline{\Delta} - \underline{\Delta})$

the difference $\Pi^M\left(\underline{\Delta};\overline{\alpha}\right)-\Pi^M\left(\overline{\Delta};\overline{\alpha}\right)$ varies with $\underline{\Delta}(\underline{\alpha})$, (actually, it decreases with $\underline{\Delta}(\underline{\alpha})$ and increases with $\overline{\Delta}(\overline{\alpha})$ through the profits respective monotonicity). To prevent this, the necessary asset transfer distortion will require first of all that $\underline{\Delta}^{SB}(\underline{\alpha})>\underline{\Delta}^{FB}(\underline{\alpha})$, so as to keep $\Pi^M\left(\underline{\Delta};\overline{\alpha}\right)-\Pi^M\left(\overline{\Delta};\overline{\alpha}\right)\leq\overline{P}-\underline{P}$. Eventually, i.e. for even higher $\underline{\alpha}$, even the other type's divestiture distortion $\overline{\Delta}^{SB}(\overline{\alpha})<\overline{\Delta}^{FB}(\overline{\alpha})$ might be necessary, not only to ensure the $\overline{\alpha}-$ type incentive constraint, but equally the $\underline{\alpha}-$ type one by the same token. But when this is the case, applying $\overline{\Delta}^{SB}(\overline{\alpha})$ to the less efficient merged entity no longer keeps the market price constant, because the required divestiture no longer induces full capacity production. Therefore, given the constant Consumer Surplus constraint, the CA will rather prevent the $\overline{\alpha}-$ type merger from being submitted by proposing a single divestiture contract, the one accepted only by the $\underline{\alpha}-$ type merger.

- Monetary transfer to the budget instead of regulating the divestiture sale price

Basically, the programme will now write:

$$\max_{\substack{\left\{(\underline{\Delta},\underline{t}),(\overline{\Delta},\overline{t})\right\}\\ \underline{\Delta}\geq 0,\overline{\Delta}\geq 0}}\rho\left(CS\left(\underline{\Delta};\underline{\alpha}\right)+\underline{t}\right)+(1-\rho)\left(CS\left(\overline{\Delta};\overline{\alpha}\right)+\overline{t}\right)$$

$$\text{s.t.}\begin{cases} CS\left(\underline{\Delta};\underline{\alpha}\right)=CS\left(\overline{\Delta};\overline{\alpha}\right)=CS_0 \\ \Pi^M\left(\underline{\Delta};\underline{\alpha}\right)+\left(\Pi^o\left(\underline{\Delta};\underline{\alpha}\right)-\Pi\right)-\underline{t}\geq\Pi^M\left(\overline{\Delta};\underline{\alpha}\right)+\left(\Pi^o\left(\overline{\Delta};\underline{\alpha}\right)-\Pi\right)-\overline{t} \\ \Pi^M\left(\overline{\Delta};\overline{\alpha}\right)+\left(\Pi^o\left(\overline{\Delta};\overline{\alpha}\right)-\Pi\right)-\overline{t}\geq\Pi^M\left(\underline{\Delta};\overline{\alpha}\right)+\left(\Pi^o\left(\underline{\Delta};\overline{\alpha}\right)-\Pi\right)-\underline{t} \\ \Pi^M\left(\underline{\Delta};\underline{\alpha}\right)+\left(\Pi^o\left(\underline{\Delta};\underline{\alpha}\right)-\Pi\right)-\underline{t}\geq 2\Pi \\ \Pi^M\left(\overline{\Delta};\overline{\alpha}\right)+\left(\Pi^o\left(\overline{\Delta};\overline{\alpha}\right)-\Pi\right)-\overline{t}\geq 2\Pi \end{cases}$$

since now the insiders capture entirely the outsider's willingness to pay for the asset transfer through the sale price they require in their take-it-or-leave-it offer[25].

Even if the CA's objective function writes now $CS(\Delta;\alpha)+t$, this will not essentially alter our initial results. To see that, note that the necessary condition (basically, the single crossing condition) for information revelation writes now:

$\left(\Pi^M\left(\underline{\Delta};\underline{\alpha}\right)+\Pi^o\left(\underline{\Delta};\underline{\alpha}\right)\right)-\left(\Pi^M\left(\overline{\Delta};\underline{\alpha}\right)+\Pi^o\left(\overline{\Delta};\underline{\alpha}\right)\right)\geq\underline{t}-\overline{t}\geq\left(\Pi^M\left(\underline{\Delta};\overline{\alpha}\right)+\Pi^o\left(\underline{\Delta};\overline{\alpha}\right)\right)-\left(\Pi^M\left(\overline{\Delta};\overline{\alpha}\right)+\Pi^o\left(\overline{\Delta};\overline{\alpha}\right)\right)$

[25] The case where both instruments are available besides the asset transfer would be much interesting, but also highly complex, and would enable the comparison between the regulation of the sale price and the tax to the regulator in terms of their respective effectiveness and efficiency as revelation instruments.

The point is, as long as one looks for the asset transfers $\Delta \leq \Delta_2$, i.e. that induce production to full capacity on behalf of the outsider and eventually satisfy $CS\left(\underline{\Delta};\underline{\alpha}\right) = CS\left(\overline{\Delta};\overline{\alpha}\right) = CS_0$, the condition $\frac{\partial^2}{\partial\Delta\partial\alpha}\left(\Pi^M\left(\Delta;\alpha\right)+\Pi^o\left(\Delta;\alpha\right)\right) < 0$ holds, which is basically the same condition as before but applied to total industry profit. To obtain the sign of this derivative it is enough to work simple derivations on the profit functions: $\Pi^M\left(\Delta;\alpha\right) = \begin{cases} \left(\frac{1+\alpha-c-k-\Delta}{2}\right)^2, \text{ if } M \text{ does not produce to full capacity} \\ \left(1-3k-c+\alpha\right)\left(2k-\Delta\right), \text{ if it does} \end{cases}$ and $\Pi^o\left(\Delta;\alpha\right) = \begin{cases} \left(\frac{1-\alpha-c-k-\Delta}{2}\right)\left(k+\Delta\right), \text{ if } M \text{ does not produce to full capacity} \\ \left(1-3k-c\right)\left(k+\Delta\right), \text{ if it does} \end{cases}$.

As before (see Lemma 6.2), the cross derivative $\frac{\partial^2}{\partial\Delta\partial\alpha}\left(\Pi^M\left(\Delta;\alpha\right)+\Pi^o\left(\Delta;\alpha\right)\right) < 0$ ensures that the revelation is possible, i.e.

$\left(\Pi^M\left(\underline{\Delta};\underline{\alpha}\right)+\Pi^o\left(\underline{\Delta};\underline{\alpha}\right)\right) - \left(\Pi^M\left(\overline{\Delta};\underline{\alpha}\right)+\Pi^o\left(\overline{\Delta};\underline{\alpha}\right)\right) >$

$\left(\Pi^M\left(\underline{\Delta};\overline{\alpha}\right)+\Pi^o\left(\underline{\Delta};\overline{\alpha}\right)\right) - \left(\Pi^M\left(\overline{\Delta};\overline{\alpha}\right)+\Pi^o\left(\overline{\Delta};\overline{\alpha}\right)\right)$.

Furthermore, $\frac{\partial}{\partial\Delta}\left(\Pi^M\left(\Delta;\alpha\right)+\Pi^o\left(\Delta;\alpha\right)\right) < 0$ for the asset transfers $\Delta \leq \Delta_2$ that we consider, which implies $\underline{t} - \overline{t} \geq 0$ since

$\left(\Pi^M\left(\underline{\Delta};\overline{\alpha}\right)+\Pi^o\left(\underline{\Delta};\overline{\alpha}\right)\right) - \left(\Pi^M\left(\overline{\Delta};\overline{\alpha}\right)+\Pi^o\left(\overline{\Delta};\overline{\alpha}\right)\right) \geq 0$.

Given all this, and following our initial reasoning on the sale prices $\underline{P}$ and $\overline{P}$ to characterize the optimal contract, the outcome will be the following: so as to ensure $CS\left(\underline{\Delta};\underline{\alpha}\right) = CS\left(\overline{\Delta};\overline{\alpha}\right) = CS_0$, the asset transfers will be the same as with symmetric information, whereas the monetary transfer will satisfy $\overline{t} = \Pi^M\left(\overline{\Delta};\overline{\alpha}\right)+\Pi^o\left(\overline{\Delta};\overline{\alpha}\right) - 3\Pi$ and $\underline{t} = \left(\Pi^M\left(\underline{\Delta};\underline{\alpha}\right)+\Pi^o\left(\underline{\Delta};\underline{\alpha}\right)\right) - \left(\Pi^M\left(\overline{\Delta};\underline{\alpha}\right)+\Pi^o\left(\overline{\Delta};\underline{\alpha}\right)\right) + \overline{t}$, where $\underline{t} \geq \overline{t}$ obviously and $\underline{t}$ also satisfies the $\underline{\alpha}$-type participation constraint. Moreover, by its very definition, combined with the single-crossing condition, $\underline{t}$ ensures the $\overline{\alpha}$-type incentive constraint. In short, this means no distortion of the asset transfers, but only of the 'tax' paid by the efficient merged entity.

If, instead, the constant Consumer Surplus constraint no longer applies, it is enough to replace the above expressions for $\underline{t}$ and $\overline{t}$ into the CA's objective function to obtain the direction of the ensuing asset transfers. More precisely, the programme becomes:

$$\max_{\underline{\Delta}\geq 0,\overline{\Delta}\geq 0}\left[\begin{array}{c}\rho\left(\begin{array}{c}CS\left(\underline{\Delta};\underline{\alpha}\right)+\left(\Pi^{M}\left(\underline{\Delta};\underline{\alpha}\right)+\Pi^{o}\left(\underline{\Delta};\underline{\alpha}\right)\right)\\-(\Pi^{M}\left(\overline{\Delta};\underline{\alpha}\right)+\Pi^{o}\left(\overline{\Delta};\underline{\alpha}\right))+\Pi^{M}\left(\overline{\Delta};\overline{\alpha}\right)+\Pi^{o}\left(\overline{\Delta};\overline{\alpha}\right)-3\Pi\end{array}\right)\\+(1-\rho)\left(CS\left(\overline{\Delta};\overline{\alpha}\right)+\Pi^{M}\left(\overline{\Delta};\overline{\alpha}\right)+\Pi^{o}\left(\overline{\Delta};\overline{\alpha}\right)-3\Pi\right)\end{array}\right]$$

Therefore, *assuming that the sum of Consumer Surplus and industry profits is concave w.r.t. the asset transfer*, the derivatives yield:

$\rho\frac{\partial}{\partial\underline{\Delta}}\left(CS\left(\underline{\Delta};\underline{\alpha}\right)+\left(\Pi^{M}\left(\underline{\Delta};\underline{\alpha}\right)+\Pi^{o}\left(\underline{\Delta};\underline{\alpha}\right)\right)\right)=0$, and

$(1-\rho)\frac{\partial}{\partial\overline{\Delta}}\left(CS\left(\overline{\Delta};\overline{\alpha}\right)+\Pi^{M}\left(\overline{\Delta};\overline{\alpha}\right)+\Pi^{o}\left(\overline{\Delta};\overline{\alpha}\right)\right)+\rho(\left(\Pi^{M}\left(\overline{\Delta};\overline{\alpha}\right)+\Pi^{o}\left(\overline{\Delta};\overline{\alpha}\right)\right)-(\Pi^{M}\left(\overline{\Delta};\underline{\alpha}\right)+\Pi^{o}\left(\overline{\Delta};\underline{\alpha}\right))=0$

Comparing with the levels $\underline{\Delta}$ and $\overline{\Delta}$ that maximize *total welfare* (and no longer Consumer Surplus) under symmetric information, $\underline{\Delta}$ is clearly the same, whereas $\overline{\Delta}$ is higher with asymmetric information, because $(1-\rho)\frac{\partial}{\partial\overline{\Delta}}\left(CS\left(\overline{\Delta};\overline{\alpha}\right)+\Pi^{M}\left(\overline{\Delta};\overline{\alpha}\right)+\Pi^{o}\left(\overline{\Delta};\overline{\alpha}\right)\right)$

$$=\rho\left(\underbrace{\left(\left(\Pi^{M}\left(\overline{\Delta};\underline{\alpha}\right)+\Pi^{o}\left(\overline{\Delta};\underline{\alpha}\right)\right)-\left(\Pi^{M}\left(\overline{\Delta};\overline{\alpha}\right)+\Pi^{o}\left(\overline{\Delta};\overline{\alpha}\right)\right)\right)}_{<0}\right)<0$$

In other words, the efficient type's tax payment is downward distorted but its asset transfer is the same as with symmetric information, whereas the inefficient type's tax payment is not distorted (it equals the entire willingness to pay), but its asset transfer exceeds the symmetric information level. ■

GENERAL CONCLUSION

The important thing is to never stop questioning...

The essays in this dissertation aimed to contribute to the theoretical analysis of horizontal mergers' rationale, market consequences and antitrust treatment. As such, they concentrated on the unilateral effects of horizontal mergers, in particular the potential efficiencies generated by the concentration, and on the merger remedies as the main instrument of merger regulation employed by competition authorities.

The first part of the thesis examined in two spatial models the individual private incentives to merge and some of the welfare consequences of such a decision, in terms of post-merger location or product design choices, the ensuing spatial equilibrium, and possibly the resulting consumer surplus. The second part of the dissertation has instead focused on the strategic interaction between the merging firms and the competition authorities in a context of asymmetric information w.r.t. the merger's competitive effect, and concluded in terms of optimal merger policy.

Although our analyses succeed in providing additional insight into the horizontal merger rationale and profitability, as well as some possible recommendations in terms of merger control, alternative approaches and assumption choices deserve notice and may provide some directions for future research. We address this next.

The first part of the dissertation contains two essays, both proposing spatial analyses of horizontal merger decisions and of their consequences by taking into account the firms'

optimal location choices following the merger. In so doing, Chapters 2 and 3 share the same underlying spatial framework, the shipping Cournot model of spatial price discrimination. More precisely, this framework is employed in its very simple but extensively used version, based on identical constant linear transport cost (in quantity shipped and distance). However, an alternative assumption, such as transport cost convexity for instance, would be useful in eliminating the less 'robust' of the multiple location equilibria obtained for the circular market merger analysis in Chapter 2. Yet, keeping the linearity assumption was essential in checking the robustness of the paradox-profitability solution proposed in the spatial literature, since the method required to keep the same assumptions save the one we wished to test for, the spatial representation of the market. In addition, the linearity assumption partly explains the multiplicity equilibria result we obtain, which does represent in itself a by-product of our analysis.

A further debatable point concerning the (un)profitability result obtained in Chapter 2 is the fact that the generalization to a n-firm oligopoly is not yet available. As one of the main problems raised is sorting out the multiple location equilibria, again, the convex transport cost may be useful, but this has been left for future research.

A similar generalization-related issue concerns the analysis proposed in Chapter 3. Admittedly, we devise a particular case to examine in a spatial setting the relationship between merger and spin-off. The point is actually to highlight the possibility of complementarity between the two business strategies, which is why we do not look for a more general set up - although it would be interesting to generalize the intuition that spin-offs (be they divisionalization or divestitures) can improve merger profitability. Arguably, several extensions would be straightforward, such as allowing for transport cost differences between the different industry firms, or considering several buyers for the spun-off assets. We leave this for further research.

The second part of this dissertation focused on asset sales as merger remedies and on cost savings stemming from merger efficiency gains, but from a normative perspective. The purpose of this second part was to examine the strategic interaction between the merging firms and the competition authorities in a reality-consistent framework of asymmetric information, so as to draw conclusions on the optimal profile of the merger policy in light

of their respective individual incentives and vested interests w.r.t. the merger' eventual market outcome.

In Chapter 5, when analyzing the impact of merger remedies on the *ex ante* incentives provided by the efficiency defence and more generally, by the merger control, a key point is the information problem that the competition authority faces w.r.t. the merger's efficiencies. Admittedly, our formal treatment of the imperfect information could be enriched, to the extent that all the relevant information is condensed in an exogenous, cost-free and imperfect signal for the competition authority to observe and exploit. We acknowledge that modelling instead the costly effort to be able to send a (credible) signal on behalf of the interested parties, or that of processing the relevant information for the antitrust agency, would result in a more realistic and rich analysis. Notwithstanding, we feel that our qualitative results would not be substantially modified.

Similarly, some particular modelling choice have important implications for the results obtained in Chapter 6. On the one hand, dealing with a capacity-constrained industry simplified the design of the contract menu we propose to extract the merging firms' private information. Our results would only gain in generality by extending this contract-theory approach to the more frequent case in the literature, that of individual cost determined by the firm's asset holdings. This extension is yet left for future research, as is the possibility to draw a more comprehensive analysis of such a revelation mechanism. More precisely, it would be useful to allow for both the regulation of the divested assets' sale price and the direct monetary transfer to the state budget as revelation instruments in the contract menu, besides the amount of the divestiture required. This would enable a comparison of the two instruments, and would therefore provide indications as to the best instrument to use. By so doing, we expect to enhance the scope of the main result of the analysis in Chapter 6, that of arguing the effectiveness of a revelation mechanism based on divestitures and their sale price.

Appendix A

Merger to duopoly

- Post-merger location equilibria

Case 1: $0 \leq z \leq d \leq 1/2 \leq z + 1/2 \leq 1 - d \leq 1$

Profit of the single-store in z:

$9 \times \Pi^{(2)}[z] = \int_0^z [a + (d - x) - 2(z - x)]^2 \, dx + \int_z^d [a + (d - x) - 2(x - z)]^2 \, dx$
$+ \int_d^{1/2} [a + (x - d) - 2(x - z)]^2 \, dx + \int_{1/2}^{z+1/2} [a + (1 - d - x) - 2(x - z)]^2 \, dx$
$+ \int_{z+1/2}^{1-d} [a + (1 - d - x) - 2(1 - x + z)]^2 \, dx + \int_{1-d}^1 [a + (x - 1 + d) - 2(1 + z - x)]^2 \, dx$
$= \frac{1}{2}d - \frac{1}{2}a - 2ad + a^2 + d^2 - \frac{8}{3}d^3 + 2z^2 + 4ad^2 - 8dz^2 + \frac{1}{12}$

First Order Condition:

$\frac{\partial}{\partial z}\left(\frac{1}{12} + a^2 - \frac{1}{2}a + \frac{1}{2}d - 8z^2d - 2ad + d^2 + 2z^2 + 4ad^2 - \frac{8}{3}d^3\right) = 4z - 16dz = 0, z = 0$

Second Order Condition:

$\frac{\partial^2}{\partial z^2}\left(\frac{1}{12} + a^2 - \frac{1}{2}a + \frac{1}{2}d - 8z^2d - 2ad + d^2 + 2z^2 + 4ad^2 - \frac{8}{3}d^3\right) = 4 - 16d \leq 0$

Profit of the merged firm:

$9 \times \Pi^{(2)}_{merged} = \int_0^z [a + (z - x) - 2(d - x)]^2 \, dx + \int_z^d [a + (x - z) - 2(d - x)]^2 \, dx$
$+ \int_d^{1/2} [a + (x - z) - 2(x - d)]^2 \, dx + \int_{1/2}^{z+1/2} [a + (x - z) - 2(1 - d - x)]^2 \, dx$
$+ \int_{z+1/2}^{1-d} [a + (1 + z - x) - 2(1 - d - x)]^2 \, dx + \int_{1-d}^1 [a + (1 + z - x) - 2(x - 1 + d)]^2 \, dx$
$= 4ad - d - \frac{1}{2}a + a^2 + 4d^2 - \frac{8}{3}d^3 + 2z^2 - 8ad^2 - 8dz^2 + \frac{1}{12}$

First Order Condition:

$\frac{\partial}{\partial d}\left(4ad - d - \frac{1}{2}a + a^2 + 4d^2 - \frac{8}{3}d^3 + 2z^2 - 8ad^2 - 8dz^2 + \frac{1}{12}\right) = 4a + 8d - 16ad - 8d^2 - 8z^2 - 1 = 0$

Solution is: $\left\{d = \frac{1}{2} - a + \frac{1}{4}\sqrt{(2 - 8a + 16a^2 - 16z^2)}\right\}, \left\{d = \frac{1}{2} - a - \frac{1}{4}\sqrt{(2 - 8a + 16a^2 - 16z^2)}\right\}$

Second Order Condition:

$\frac{\partial^2}{\partial d^2}\left(4ad - d - \frac{1}{2}a + a^2 + 4d^2 - \frac{8}{3}d^3 + 2z^2 - 8ad^2 - 8dz^2 + \frac{1}{12}\right) = 8 - 16d - 16a \leq 0,$

Solution is: $\left\{\frac{1}{2} - a \leq d\right\}$

Since: $\left[\frac{1}{2} - a + \frac{1}{4}\sqrt{(2 - 8a + 16a^2 - 16z^2)}\right]_{z=0} = \frac{1}{2} - a + \frac{1}{4}\sqrt{(2 - 8a + 16a^2)} > 1/4$, the solution (z,d) to the system of FOCs satisfying the SOCs is: $\boxed{z = 0,\ d = \frac{1}{2} - a + \frac{1}{4}\sqrt{(2 - 8a + 16a^2)}}$

Case 2: $0 \leq z \leq d \leq 1/2 \leq 1 - d \leq z + 1/2 \leq 1$

Profit of the single-store in z:

$9 \times \Pi^{(2)}[z] = \int_0^z [a + (d - x) - 2(z - x)]^2\, dx + \int_z^d [a + (d - x) - 2(x - z)]^2\, dx$
$+ \int_d^{1/2} [a + (x - d) - 2(x - z)]^2\, dx + \int_{1/2}^{1-d} [a + (1 - d - x) - 2(x - z)]^2\, dx$
$+ \int_{1-d}^{z+1/2} [a + (x - 1 + d) - 2(x - z)]^2\, dx + \int_{z+1/2}^1 [a + (x - 1 + d) - 2(1 + z - x)]^2\, dx$
$= \frac{5}{2}d - \frac{1}{2}a + 2z - 2ad - 8dz + a^2 - 3d^2 - 2z^2 + \frac{8}{3}z^3 + 4ad^2 + 8d^2z - \frac{1}{4}$

First Order Condition:

$\frac{\partial}{\partial z}\left(\frac{5}{2}d - \frac{1}{2}a + 2z - 2ad - 8dz + a^2 - 3d^2 - 2z^2 + \frac{8}{3}z^3 + 4ad^2 + 8d^2z - \frac{1}{4}\right) = 8d^2 - 4z - 8d + 8z^2 + 2$, Solution is: $\left\{z = \frac{1}{4} + \frac{1}{4}\sqrt{(-3 + 16d - 16d^2)}\right\}, \left\{z = \frac{1}{4} - \frac{1}{4}\sqrt{(-3 + 16d - 16d^2)}\right\}$

Second Order Condition:

$\frac{\partial^2}{\partial z^2}\left(\frac{5}{2}d - \frac{1}{2}a + 2z - 2ad - 8dz + a^2 - 3d^2 - 2z^2 + \frac{8}{3}z^3 + 4ad^2 + 8d^2z - \frac{1}{4}\right) = 16z - 4 \leq 0$, Solution is: $\left\{z \leq \frac{1}{4}\right\}$

Profit of the merged firm:

$9 \times \Pi^{(2)}_{merged} = \int_0^z [a + (z - x) - 2(d - x)]^2\, dx + \int_z^d [a + (x - z) - 2(d - x)]^2\, dx$
$+ \int_d^{1/2} [a + (x - z) - 2(x - d)]^2\, dx + \int_{1/2}^{1-d} [a + (x - z) - 2(1 - d - x)]^2\, dx$
$+ \int_{1-d}^{z+1/2} [a + (x - z) - 2(x - 1 + d)]^2\, dx + \int_{z+1/2}^1 [a + (1 + z - x) - 2(x - 1 + d)]^2\, dx$
$= d - \frac{1}{2}a + 2z + 4ad - 8dz + a^2 - 2z^2 + \frac{8}{3}z^3 - 8ad^2 + 8d^2z - \frac{1}{4}$

First Order Condition:

$\frac{\partial}{\partial d}\left(d - \frac{1}{2}a + 2z + 4ad - 8dz + a^2 - 2z^2 + \frac{8}{3}z^3 - 8ad^2 + 8d^2z - \frac{1}{4}\right) = 4a - 8z - 16ad + 16dz + 1 = 0$, Solution is: $\left\{d = \frac{1}{16}\frac{1 + 4a - 8z}{a - z}\right\}$

Second Order Condition:

$\frac{\partial^2}{\partial d^2}\left(d-\frac{1}{2}a+2z+4ad-8dz+a^2-2z^2+\frac{8}{3}z^3-8ad^2+8d^2z-\frac{1}{4}\right)=16z-16a\leq 0$,
Solution is $\{z\leq a\}$ Always satisfied

We solve for the solution of the FOCs simultaneous system: $\begin{cases} z=\frac{1}{4}-\frac{1}{4}\sqrt{(-3+16d-16d^2)} \\ d=\frac{1}{16}\frac{1+4a-8z}{a-z} \end{cases}$
and find that the solution satisfying the SOCs and the initial conditions is: $\boxed{z=1/4=d, 1-d=3/4}$

Case 3: $0\leq d\leq z\leq 1/2\leq 1-d\leq z+1/2\leq 1$

Profit of the single-store in z:

$9\times\Pi^{(2)}[z]=\int_0^d[a+(d-x)-2(z-x)]^2dx+\int_d^z[a+(x-d)-2(z-x)]^2dx$
$+\int_z^{1/2}[a+(x-d)-2(x-z)]^2dx+\int_{1/2}^{1-d}[a+(1-d-x)-2(x-z)]^2dx$
$+\int_{1-d}^{z+1/2}[a+(x-1+d)-2(x-z)]^2dx+\int_{z+1/2}^1[a+(x-1+d)-2(1+z-x)]^2dx$
$=\frac{5}{2}d-\frac{1}{2}a+2z-2ad-8dz+a^2-3d^2+\frac{8}{3}d^3-2z^2+4ad^2+8dz^2-\frac{1}{4}$

First Order Condition:

$\frac{\partial}{\partial z}\left(\frac{5}{2}d-\frac{1}{2}a+2z-2ad-8dz+a^2-3d^2+\frac{8}{3}d^3-2z^2+4ad^2+8dz^2-\frac{1}{4}\right)=16dz-4z-8d+2=0$, Solution is: $\left\{z=\frac{1}{2}\right\}$

Second Order Condition:

$\frac{\partial^2}{\partial z^2}\left(\frac{5}{2}d-\frac{1}{2}a+2z-2ad-8dz+a^2-3d^2+\frac{8}{3}d^3-2z^2+4ad^2+8dz^2-\frac{1}{4}\right)=16d-4\leq 0$, Solution is: $\left\{d\leq\frac{1}{4}\right\}$

Profit of the merged firm:

$9\times\Pi^{(2)}_{merged}=\int_0^d[a+(z-x)-2(d-x)]^2dx+\int_d^z[a+(z-x)-2(x-d)]^2dx$
$+\int_z^{1/2}[a+(x-z)-2(x-d)]^2dx+\int_{1/2}^{1-d}[a+(x-z)-2(1-d-x)]^2dx$
$+\int_{1-d}^{z+1/2}[a+(x-z)-2(x-1+d)]^2dx+\int_{z+1/2}^1[a+(1-x+z)-2(x-1+d)]^2dx$
$=d-\frac{1}{2}a+2z+4ad-8dz+a^2+\frac{8}{3}d^3-2z^2-8ad^2+8dz^2-\frac{1}{4}$

First Order Condition:

$\frac{\partial}{\partial d}\left(d-\frac{1}{2}a+2z+4ad-8dz+a^2+\frac{8}{3}d^3-2z^2-8ad^2+8dz^2-\frac{1}{4}\right)=04a-8z-16ad+8d^2+8z^2+1=0$,

Solution is: $\left\{d=a+\frac{1}{4}\sqrt{(16a^2-2-8a+16z-16z^2)}\right\},\left\{d=a-\frac{1}{4}\sqrt{(16a^2-2-8a+16z-16z^2)}\right\}$

Second Order Condition:

$\frac{\partial^2}{\partial d^2}\left(d-\frac{1}{2}a+2z+4ad-8dz+a^2+\frac{8}{3}d^3-2z^2-8ad^2+8dz^2-\frac{1}{4}\right)=16d-16a\leq 0$,
Solution is: $\{d\leq a\}$ Always satisfied.

Since $\left[a - \frac{1}{4}\sqrt{(16a^2 - 2 - 8a + 16z - 16z^2)}\right]_{z=1/2} = a - \frac{1}{4}\sqrt{(16a^2 + 2 - 8a)} < 1/4$, the solution of the system of simultaneous FOCs is: $\boxed{z = 1/2,\ d = a - \frac{1}{4}\sqrt{(16a^2 + 2 - 8a)}}$

Remark: case 3 basically coincides with case 1, up to a 180° rotation; optimal z is now opposite to its first value, and the optimal d-s are in fact symmetric w.r.t the 1/4 point.

- Profitability analysis

Evaluating the merged profit for the Type 1 pattern:

$$\Pi^{(2)}_{merged}\,[type\ 1] = \frac{1}{9}\left[\begin{array}{c} 4ad - d - \frac{1}{2}a + a^2 + 4d^2 \\ -\frac{8}{3}d^3 + 2z^2 - 8ad^2 - 8dz^2 + \frac{1}{12} \end{array}\right]_{z=0,d=\frac{1}{2}-a+\frac{1}{4}\sqrt{(2-8a+16a^2)}}$$

$$= \left(5a^2 - \frac{3}{2}a - \frac{16}{3}a^3 + \frac{1}{6}\sqrt{2}\sqrt{8a^2 - 4a + 1} - \frac{2}{3}a\sqrt{2}\sqrt{8a^2 - 4a + 1} + \frac{4}{3}a^2\sqrt{2}\sqrt{8a^2 - 4a + 1} + \frac{1}{4}\right)\frac{1}{9}$$

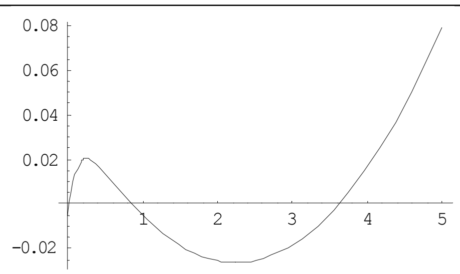
Evaluating the merged profit for the Type 2 pattern:

$$\Pi^{(2)}_{merged}\,[type\ 2] = \frac{1}{9}\left[d - \frac{1}{2}a + 2z + 4ad - 8dz + a^2 - 2z^2 + \frac{8}{3}z^3 - 8ad^2 + 8d^2z - \frac{1}{4}\right]_{z=1/4,d=1/4}$$

$$= \frac{1}{9}\left(a^2 + \frac{1}{24}\right)$$

Profitability for Type 1 post-merger equilibrium:

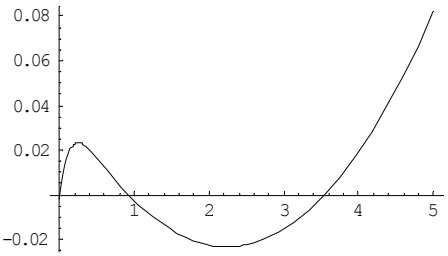
$\sum\Pi$ equidistant firms $- \Pi^{(2)}_{merged}[type\ 1]$
$= 2 \times \frac{1}{16} \times \left(\frac{127}{324} - \frac{1}{2}a + a^2\right)$
$-\frac{1}{9}\left(\begin{array}{c} 5a^2 - \frac{3}{2}a - \frac{16}{3}a^3 + \frac{1}{6}\sqrt{2}\sqrt{8a^2 - 4a + 1} \\ -\frac{2}{3}a\sqrt{2}\sqrt{8a^2 - 4a + 1} + \frac{4}{3}a^2\sqrt{2}\sqrt{8a^2 - 4a + 1} + \frac{1}{4} \end{array}\right)$
$= \frac{55}{2592} + \frac{5}{48}a - \frac{31}{72}a^2 - \frac{1}{54}\sqrt{(2 - 8a + 16a^2)}$
$+\frac{2}{27}a\sqrt{(2 - 8a + 16a^2)} - \frac{4}{27}a^2\sqrt{(2 - 8a + 16a^2)} + \frac{16}{27}a^3$
	`PlotAHH55LêH2592LL+H5êH48LL a-HH31LêH72LL a^2-`
	`H1êH54LL è H2-8 a+16 a^2L+`
	`H2êH27LL a è H2-8 a+16 a^2L-`
	`H4êH27LL a^2 è H2-8 a+16 a^2L+HH16LêH27LL a^3,`
	`8a, 0, 5<E`

Plotting this expression with Mathematica shows that the range of profitability is $a \in (1.5, 3.6]$:	

$$\sum\text{profits diametrical firms (firms at 0 and 1/2)} - \Pi^{(2)}_{merged}[type\ 1]$$
$$= \tfrac{1}{16}\left(-\tfrac{1}{2}a + a^2 + \tfrac{1}{4}\right) + \tfrac{1}{16}\left(\tfrac{7}{12} - \tfrac{1}{2}a + a^2\right) -$$
$$\tfrac{1}{9}\begin{pmatrix} -\tfrac{3}{2}a + \tfrac{1}{4} + 5a^2 + \tfrac{1}{6}\sqrt{(2-8a+16a^2)} \\ -\tfrac{2}{3}a\sqrt{(2-8a+16a^2)} + \tfrac{4}{3}a^2\sqrt{(2-8a+16a^2)} - \tfrac{16}{3}a^3 \end{pmatrix}$$
$$= \tfrac{5}{48}a - \tfrac{31}{72}a^2 + \tfrac{7}{288} - \tfrac{1}{54}\sqrt{(2-8a+16a^2)}$$
$$+\tfrac{2}{27}a\sqrt{(2-8a+16a^2)} - \tfrac{4}{27}a^2\sqrt{(2-8a+16a^2)} + \tfrac{16}{27}a^3$$

```
PlotAH5êH48LL a-HH31LêH72LL a^2+H7êH288LL-
 H1êH54LL è!!!!H2-8 a+16 a^2L+
 H2êH27LL a è!!!!H2-8 a+16 a^2L-
 H4êH27LL a^2 è!!!!H2-8 a+16 a^2L+HH16LêH27LL a^3,
8a, 0, 5<E
```

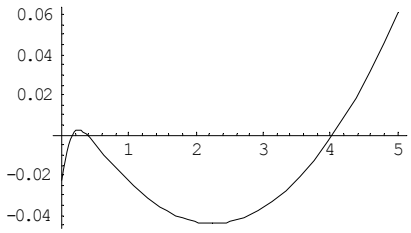
Plotting this expression with Mathematica shows that the range of profitability is $a \in (1.5, 3.57]$



$$\sum\text{profits common location firms (firms at 0)} - \Pi^{(2)}_{merged}[type\ 1]$$
$$= 2 \times \tfrac{1}{16}\left(-\tfrac{1}{2}a + a^2 + \tfrac{1}{4}\right) -$$
$$\tfrac{1}{9}\begin{pmatrix} -\tfrac{3}{2}a + \tfrac{1}{4} + 5a^2 + \tfrac{1}{6}\sqrt{(2-8a+16a^2)} - \\ \tfrac{2}{3}a\sqrt{(2-8a+16a^2)} + \tfrac{4}{3}a^2\sqrt{(2-8a+16a^2)} - \tfrac{16}{3}a^3 \end{pmatrix}$$
$$= \tfrac{5}{48}a - \tfrac{31}{72}a^2 + \tfrac{1}{288} - \tfrac{1}{54}\sqrt{(2-8a+16a^2)}$$
$$+\tfrac{2}{27}a\sqrt{(2-8a+16a^2)} - \tfrac{4}{27}a^2\sqrt{(2-8a+16a^2)} + \tfrac{16}{27}a^3$$

```
PlotAH5êH48LL a-HH31LêH72LL a^2+H1êH288LL-
 H1êH54LL è!!!!H2-8 a+16 a^2L+
 H2êH27LL a è!!!!H2-8 a+16 a^2L-
 H4êH27LL a^2 è!!!!H2-8 a+16 a^2L+HH16LêH27LL a^3,
8a, 0, 5<E
```

Plotting this expression with Mathematica shows that the range of profitability is $a \in (1.5, 4.01]$



Profitability for Type 2 post-merger equilibrium:

$\sum$profits equidistant firms - $\Pi^{(2)}_{merged}[type\ 2] =$
$2 \times \frac{1}{16} \times \left(\frac{127}{324} - \frac{1}{2}a + a^2\right) - \frac{1}{9}\left(a^2 + \frac{1}{24}\right) = \frac{115}{2592} - \frac{1}{16}a + \frac{1}{72}a^2$
$\frac{115}{2592} - \frac{1}{16}a + \frac{1}{72}a^2 \leq 0$, Solution is: $\{0.883\,23 \leq a, a \leq 3.616\,8\}$
Therefore the merger is profitable if $a \in (1.5, 3.61]$.

$\sum$profits diametrical firms (firms at 0 and 1/2) - $\Pi^{(2)}_{merged}[type\ 2] =$
$\frac{1}{16}\left(-\frac{1}{2}a + a^2 + \frac{1}{4}\right) + \frac{1}{16}\left(\frac{7}{12} - \frac{1}{2}a + a^2\right) - \frac{1}{9}\left(a^2 + \frac{1}{24}\right) = -\frac{1}{16}a + \frac{1}{72}a^2 + \frac{41}{864}$
$-\frac{1}{16}a + \frac{1}{72}a^2 + \frac{41}{864} \leq 0$, Solution is: $\{0.967\,10 \leq a, a \leq 3.532\,9\}$
Therefore the merger is profitable if $a \in (1.5, 3.53]$.

$\sum$profits common location firms (firms at 0) - $\Pi^{(2)}_{merged}[type\ 2] =$
$2 \times \frac{1}{16}\left(-\frac{1}{2}a + a^2 + \frac{1}{4}\right) - \frac{1}{9}\left(a^2 + \frac{1}{24}\right) = -\frac{1}{16}a + \frac{1}{72}a^2 + \frac{23}{864}$
$-\frac{1}{16}a + \frac{1}{72}a^2 + \frac{23}{864} \leq 0$, Solution is: $\{0.476\,35 \leq a, a \leq 4.023\,6\}$
Therefore the merger is profitable if $a \in (1.5, 4.023]$.

These results are summarized in Table 2.1.

Merger to triopoly

- Location equilibria

For each subcase, we explicitly write the profit functions and derive the optimal locations by solving out for the solution of the system of three FOCs and checking against the SOCs (unknowns are z, y, and d). The equilibrium values are obtained with Mathematica and summarized at the end of this subsection.

Case 1: $0 \leqslant z \leqslant y \leqslant d \leq 1/2 \leq z + 1/2 \leq y + 1/2 \leq 1 - d \leq 1$

Profit of outsider located at z:

$\Pi^{(3)}[z]\times 16 = \int_0^z [a + (y - x) + (d - x) - 3(z - x)]^2\,dx + \int_z^y [a + (y - x) + (d - x) - 3(x - z)]^2\,dx$
$+ \int_y^d [a + (x - y) + (d - x) - 3(x - z)]^2\,dx + \int_d^{1/2} [a + (x - y) + (x - d) - 3(x - z)]^2\,dx$
$+ \int_{1/2}^{z+1/2} [a + (x - y) + (1 - d - x) - 3(x - z)]^2\,dx + \int_{z+1/2}^{y+1/2} \left[\begin{array}{c} a + (x - y) + (1 - d - x) \\ -3(1 - x + z) \end{array}\right]^2 dx$
$+ \int_{y+1/2}^{1-d} \left[\begin{array}{c} a + (1 - x + y) + (1 - d - x) \\ -3(1 - x + z) \end{array}\right]^2 dx + \int_{1-d}^{1} \left[\begin{array}{c} a + (1 - x + y) + (x - 1 + d) \\ -3(1 - x + z) \end{array}\right]^2 dx$
$= \frac{1}{2}d - \frac{1}{2}a - 2ad - 6yz + a^2 + d^2 - \frac{8}{3}d^3 + 2y^2 - 4y^3$
$+6z^2 + 4z^3 + 4ad^2 + 4dy^2 - 12dz^2 - 12yz^2 + 12y^2z + \frac{1}{12}$

First Order Condition:

$\frac{\partial}{\partial z}\Pi^{(3)}[z] = -24yz - 24dz - 6y + 12y^2 + 12z^2 + 12z = 0$

Second Order Condition:

$\frac{\partial^2}{\partial z^2}\Pi^{(3)}[z] = -24y - 24d + 24z + 12 \leq 0$, Solution is: $\left\{z \leq y + d - \frac{1}{2}\right\}$

Profit of outsider firm located at y:

$\Pi^{(3)}[y]\times 16 = \int_0^z [a+(z-x)+(d-x)-3(y-x)]^2\,dx + \int_z^y [a+(x-z)+(d-x)-3(y-x)]^2\,dx$
$+\int_y^d [a+(x-z)+(d-x)-3(x-y)]^2\,dx + \int_d^{1/2} [a+(x-z)+(x-d)-3(x-y)]^2\,dx$
$+\int_{1/2}^{z+1/2} [a+(x-z)+(1-d-x)-3(x-y)]^2\,dx + \int_{z+1/2}^{y+1/2} \begin{bmatrix} a+(1-x+z)+ \\ (1-d-x)-3(x-y) \end{bmatrix}^2 dx$
$+\int_{y+1/2}^{1-d} \begin{bmatrix} a+(1-x+z)+(1-d-x) \\ -3(1-x+y) \end{bmatrix}^2 dx + \int_{1-d}^{1} \begin{bmatrix} a+(1-x+z)+(x-1+d) \\ -3(1-x+y) \end{bmatrix}^2 dx$
$= \frac{1}{2}d - \frac{1}{2}a - 2ad - 6yz + a^2 + d^2 - \frac{8}{3}d^3 + 6y^2 - 4y^3$
$+2z^2 + 4z^3 + 4ad^2 - 12dy^2 + 4dz^2 - 12yz^2 + 12y^2z + \frac{1}{12}$

First Order Condition:

$\frac{\partial}{\partial y}\Pi^{(3)}[y] = 12y - 6z - 12z^2 + 24yz - 12y^2 - 24dy = 0$

Second Order Condition:

$\frac{\partial^2}{\partial y^2}\Pi^{(3)}[y] = -24y - 24d + 24z + 12 \leq 0$, Solution is: $\left\{-d + z + \frac{1}{2} \leq y\right\}$

Profit of the merged firm:

$\Pi^{(3)}_{merged}\times 16 = \int_0^z [a+(z-x)+(y-x)-3(d-x)]^2\,dx + \int_z^y [a+(x-z)+(y-x)-3(d-x)]^2\,dx$
$+\int_y^d [a+(x-z)+(x-y)-3(d-x)]^2\,dx + \int_d^{1/2} [a+(x-z)+(x-y)-3(x-d)]^2\,dx +$
$\int_{1/2}^{z+1/2} [a+(x-z)+(x-y)-3(1-d-x)]^2\,dx + \int_{z+1/2}^{y+1/2} \begin{bmatrix} a+(1-x+z)+ \\ (x-y)-3(1-d-x) \end{bmatrix}^2 dx +$
$\int_{y+1/2}^{1-d} [a+(1-x+z)+(1-x+y)-3(1-d-x)]^2\,dx + \int_{1-d}^{1} \begin{bmatrix} a+(1-x+z)+ \\ (1-x+y)-3(x-1+d) \end{bmatrix}^2 dx$
$= -\frac{3}{2}d + 2y^2 + 2yz + 2z^2 + \frac{1}{12} - 12z^2d + 4z^2y + 9d^2 - 4zy^2 - \frac{4}{3}z^3 + \frac{4}{3}y^3 - 12dy^2 - 8d^3 -$
$\frac{1}{2}a + a^2 + 6ad - 12ad^2$

First Order Condition:

$\frac{\partial}{\partial d}\Pi^{(3)}_{merged} = -\frac{3}{2} - 12z^2 + 18d - 12y^2 - 24d^2 + 6a - 24ad = 0$

Second Order Condition:

$\frac{\partial^2}{\partial d^2}\Pi^{(3)}_{merged} = 18 - 48d - 24a \leq 0$, Solution is: $\left\{\frac{3}{8} - \frac{1}{2}a \leq d\right\}$

The simultaneous system of FOCs is solved with Mathematica:

```
z  Reals&&y  Reals&&d  Reals&&a  Reals;
z≥0&&y≥0&&d>0&&a>2;
Reduce@8-H3ê2L-12 z^2+18 d-12 y^2-24 d^2+6 a-24 a d« 0,
  12 y-6 z-12 z^2+24 y z-12 y^2-24 d y« 0,
  -24 y z-24 d z-6 y+12 y^2+12 z^2+12 z« 0<, 8z, y, d<D
```

Out[3]= $d == \frac{1}{4}$ && $y == -\frac{1}{4}$ && $z == -\frac{1}{4}$ »»

$d == \frac{1}{4}$ && $y == \frac{1}{4}$ && $z == -\frac{1}{4}$ »» $d == \frac{1}{4}$ && $y == \frac{1}{4}$ && $z == \frac{1}{4}$ »»

$d == \frac{1}{20}$ H13 − 16 aL && $y == \frac{1}{20}$ H1 + 8 aL && $z == \frac{1}{20}$ H−1 − 8 aL »»

$d == \frac{1}{8}\left(3 - 4a - \sqrt{5 - 8a + 16a^2}\right)$ && $y == 0$ && $z == 0$ »»

$d == \frac{1}{8}\left(3 - 4a + \sqrt{5 - 8a + 16a^2}\right)$ && $y == 0$ && $z == 0$

None of these solutions is compatible with either the initial conditions defining case 1 or the SOCs. (For instance, $d = z = y = 1/4$ contredicts the SOC w.r.t.y: $-d + z + \frac{1}{2} \leq y \Leftrightarrow -\frac{1}{4} + \frac{1}{4} + \frac{1}{2} \leq \frac{1}{4}$).

Case 2: $0 \leq z \leq y \leq d \leq 1/2 \leq 1 - d \leq z + 1/2 \leqslant y + 1/2 \leqslant 1$

Profit of outsider firm located at z:

$$\Pi^{(3)}[z]\times 16 = \int_0^z [a + (y-x) + (d-x) - 3(z-x)]^2\,dx + \int_z^y [a + (y-x) + (d-x) - 3(x-z)]^2\,dx$$
$$+ \int_y^d [a + (x-y) + (d-x) - 3(x-z)]^2\,dx + \int_d^{1/2} [a + (x-y) + (x-d) - 3(x-z)]^2\,dx$$
$$+ \int_{1/2}^{1-d} [a + (x-y) + (1-d-x) - 3(x-z)]^2\,dx + \int_{1-d}^{z+1/2} a + [(x-y) + (x-1+d) - 3(x-z)]^2\,dx$$
$$+ \int_{z+1/2}^{y+1/2} \begin{bmatrix} a + (x-y) + (x-1+d) \\ -3(1+z-x) \end{bmatrix}^2 dx + \int_{y+1/2}^{1} \begin{bmatrix} a + (1+y-x) + (x-1+d) \\ -3(1+z-x) \end{bmatrix}^2 dx$$
$$= \tfrac{5}{2}d - y + 4y^2 + 4yd - 6yz - 3d^2 - 12dz + 12zy^2 + 12zd^2 - 4d^2y + 8z^3 - \tfrac{1}{4} - \tfrac{16}{3}y^3 + 3z - 12z^2y + a^2 - \tfrac{a}{2}$$

First Order Condition:

$\frac{\partial}{\partial z}\Pi^{(3)}[z] = -6y - 12d + 12y^2 + 12d^2 + 24z^2 + 3 - 24yz = 0$

Second Order Condition:

$\frac{\partial^2}{\partial z^2}\Pi^{(3)}[z] = 48z - 24y \leq 0$, Solution is: $\left\{z \leq \frac{1}{2}y\right\}$

Profit of outsider firm located at y:

$$\Pi^{(3)}[y]\times 16 = \int_0^z [a + (z-x) + (d-x) - 3(y-x)]^2\,dx + \int_z^y [a + (x-z) + (d-x) - 3(y-x)]^2\,dx$$
$$+ \int_y^d [a + (x-z) + (d-x) - 3(x-y)]^2\,dx + \int_d^{1/2} [a + (x-z) + (x-d) - 3(x-y)]^2\,dx$$
$$+ \int_{1/2}^{1-d} [a + (x-z) + (1-d-x) - 3(x-y)]^2\,dx + \int_{1-d}^{z+1/2} [a + (x-z) + (x-1+d) - 3(x-y)]^2\,dx$$

$$+\int_{z+1/2}^{y+1/2}\left[\begin{array}{c}a+(1-x+z)\\+(x-1+d)-3(x-y)\end{array}\right]^2dx+\int_{y+1/2}^{1}\left[\begin{array}{c}a+(1+z-x)+\\(x-1+d)-3(1+y-x)\end{array}\right]^2dx$$
$$=\tfrac{5}{2}d+3y-12yd-6yz-3d^2+4dz+12zy^2-4zd^2+12d^2y+\tfrac{8}{3}z^3+4z^2-\tfrac{1}{4}-z-12z^2y+a^2-\tfrac{a}{2}$$

First Order Condition:

$\frac{\partial}{\partial y}\Pi^{(3)}[y]=3-12d-6z+24yz+12d^2-12z^2=0$

Second Order Condition:

$\frac{\partial^2}{\partial y^2}\Pi^{(3)}[y]=24z\leq 0$

Remark: Given this Second Order Condition, case 2 cannot possibly obtain rational and positive solutions.

Case 3: $0\leq d\leqslant z\leqslant y\leqslant 1/2\leq 1-d\leq z+1/2\leq y+1/2\leq 1$

Profit of outsider firm located at z:

$$\Pi^{(3)}[z]\times 16=\int_0^d[a+(d-x)+(y-x)-3(z-x)]^2dx+\int_d^z[a+(x-d)+(y-x)-3(z-x)]^2dx$$
$$+\int_z^y[a+(x-d)+(y-x)-3(x-z)]^2dx+\int_y^{1/2}[a+(x-d)+(x-y)-3(x-z)]^2dx$$
$$+\int_{1/2}^{1-d}[a+(1-d-x)+(x-y)-3(x-z)]^2dx+\int_{1-d}^{z+1/2}[a+(x-1+d)+(x-y)-3(x-z)]^2dx$$
$$+\int_{z+1/2}^{y+1/2}[a+(x-1+d)+(x-y)-3(1+z-x)]^2dx+\int_{y+1/2}^{1}\left[\begin{array}{c}a+(x-1+d)+\\(1+y-x)-3(1+z-x)\end{array}\right]^2dx$$
$$=\tfrac{5}{2}d-y+12z^2d+4y^2+4yd-6yz-3d^2-12dz+12zy^2-4dy^2$$
$$+4z^3-\tfrac{1}{4}+\tfrac{8}{3}d^3-4y^3+3z-12z^2y+a^2-\tfrac{a}{2}$$

First Order Condition:

$\frac{\partial}{\partial z}\Pi^{(3)}[z]=24dz-6y-12d+12y^2+12z^2+3-24yz=0$

Second Order Condition:

$\frac{\partial^2}{\partial z^2}\Pi^{(3)}[z]=24d+24z-24y\leq 0$, Solution is: $\{z\leq -d+y\}$

Profit of outsider firm located at y:

$$\Pi^{(3)}[y]\times 16=\int_0^d[a+(d-x)+(z-x)-3(y-x)]^2dx+\int_d^z[a+(x-d)+(z-x)-3(y-x)]^2dx$$
$$+\int_z^y[a+(x-d)+(x-z)-3(y-x)]^2dx+\int_y^{1/2}[a+(x-d)+(x-z)-3(x-y)]^2dx$$
$$+\int_{1/2}^{1-d}[a+(1-d-x)+(x-z)-3(x-y)]^2dx+\int_{1-d}^{z+1/2}[a+(x-1+d)+(x-z)-3(x-y)]^2dx$$
$$+\int_{z+1/2}^{y+1/2}[a+(x-1+d)+(1-x+z)-3(x-y)]^2dx+\int_{y+1/2}^{1}\left[\begin{array}{c}a+(x-1+d)+\\(1+z-x)-3(1+y-x)\end{array}\right]^2dx$$

$= \frac{5}{2}d + 3y - 4z^2d - 12yd - 6yz - 3d^2 + 4dz + 12zy^2 + 12dy^2 + 4z^3 + 4z^2 - \frac{1}{4} + \frac{8}{3}d^3 - 4y^3 - z - 12z^2y + a^2 - \frac{a}{2}$

First Order Condition:

$\frac{\partial}{\partial y}\Pi^{(3)}[y] = 3 - 12d - 6z + 24yz + 24yd - 12y^2 - 12z^2 = 0$

Second Order Condition:

$\frac{\partial^2}{\partial y^2}\Pi^{(3)}[y] = 24d + 24z - 24y \leq 0$, Solution is: $\{d + z \leq y\}$

Profit of the merged firm

$\Pi^{(3)}_{merged} \times 16 = \int_0^d [a + (y - x) + (z - x) - 3(d - x)]^2 dx + \int_d^z [a + (y - x) + (z - x) - 3(x - d)]^2 dx$
$+ \int_z^y [a + (y - x) + (x - z) - 3(x - d)]^2 dx + \int_y^{1/2} [a + (x - y) + (x - z) - 3(x - d)]^2 dx$
$+ \int_{1/2}^{1-d} [a + (x - y) + (x - z) - 3(1 - d - x)]^2 dx + \int_{1-d}^{z+1/2} [a + (x - y) + (x - z) - 3(x - 1 + d)]^2 dx$
$+ \int_{z+1/2}^{y+1/2} [a + (x - y) + (1 - x + z) - 3(x - 1 + d)]^2 dx + \int_{y+1/2}^{1} \left[\begin{array}{c} a + (1 - x + y) + \\ (1 + z - x) - 3(x - 1 + d) \end{array} \right]^2 dx$
$= \frac{9}{2}d + 3y + 12z^2d - 4y^2 - 12yd + 2yz - 3d^2 - 12dz - 4zy^2 + 12dy^2 - \frac{4}{3}z^3 - 4z^2$
$+ 8d^3 + \frac{4}{3}y^3 - \frac{1}{2}a + a^2 + 3z + 4z^2y - 12ad^2 + 6ad - \frac{11}{12}$

First Order Condition:

$\frac{\partial}{\partial d}\Pi^{(3)}_{merged} = \frac{9}{2} + 12z^2 - 12y - 6d - 12z + 12y^2 + 24d^2 - 24ad + 6a = 0$

Second Order Condition:

$\frac{\partial^2}{\partial d^2}\Pi^{(3)}_{merged} = -6 + 48d - 24a \leq 0$, Solution is: $\left\{d \leq \frac{1}{8} + \frac{1}{2}a\right\}$

The simultaneous system of FOCs is solved with Mathematica:

```
In[1]:= Reduce@
          8H9ê2L+12 z^2-12 y-6 d-12 z+12 y^2+
            24 d^2-24 a d+6 a« 0,
           3-12 d-6 z+24 y z+24 y d-12 y^2-12 z^2« 0,
           24 d z-6 y-12 d+12 y^2+12 z^2+3-24 y z« 0<,
          8z, y, d<D

Out[1]= d== 1/4 && y== 1/4 && z== 1/4 »»
        d== 1/4 && y== 3/4 && z== 1/4 »» d== 1/4 && y== 3/4 && z== 3/4 »»
        d== 1/20 H-3+16 aL && y== 1/20 H11+8 aL && z== 1/20 H9-8 aL »»
        d== 1/8 i1+4 a-" 5-8 a+16 a^2 y && y== 1/2 && z== 1/2 »»
        d== 1/8 i1+4 a+" 5-8 a+16 a^2 y && y== 1/2 && z== 1/2
```

However, none of these solutions is compatible with either the initial conditions defining

case 3, or the SOCs. Case 3 obtains no valid solution.

Case 4: $0 \leq z \leq y \leq d \leq 1/2 \leq z+1/2 \leq 1-d \leq y+1/2 \leq 1$

Profit of outsider firm located at z:

$$\Pi^{(3)}[z]\times 16 = \int_0^z [a+(y-x)+(d-x)-3(z-x)]^2\,dx + \int_z^y [a+(y-x)+(d-x)-3(x-z)]^2\,dx$$
$$+ \int_y^d [a+(x-y)+(d-x)-3(x-z)]^2\,dx + \int_d^{1/2} [a+(x-y)+(x-d)-3(x-z)]^2\,dx$$
$$+ \int_{1/2}^{z+1/2} [a+(x-y)+(1-d-x)-3(x-z)]^2\,dx + \int_{z+1/2}^{1-d} \left[\begin{array}{c} a+(x-y)+ \\ (1-d-x)-3(1+z-x) \end{array}\right]^2 dx$$
$$+ \int_{1-d}^{y+1/2} [a+(x-y)+(x-1+d)-3(1+z-x)]^2\,dx + \int_{y+1/2}^{1} \left[\begin{array}{c} a+(1+y-x)+ \\ (x-1+d)-3(1+z-x) \end{array}\right]^2 dx$$
$$= -y - \tfrac{1}{2}d - 12z^2y - 12z^2d + 4y^2 + 4yd - 6yz + 3d^2$$
$$+12zy^2 + 4z^3 + 6z^2 - \tfrac{16}{3}y^3 - 4d^2y - 4d^3 + \tfrac{1}{4} + a^2 - \tfrac{a}{2}$$

First Order Condition:

$$\tfrac{\partial}{\partial z}\Pi^{(3)}[z] = -24yz - 24dz - 6y + 12y^2 + 12z^2 + 12z = 0$$

Second Order Condition:

$\tfrac{\partial^2}{\partial z^2}\Pi^{(3)}[z] = -24y - 24d + 24z + 12 \leq 0$, Solution is: $\left\{z \leq y + d - \tfrac{1}{2}\right\}$

Profit of outsider firm located at y:

$$\Pi^{(3)}[y]\times 16 = \int_0^z [a+(z-x)+(d-x)-3(y-x)]^2\,dx + \int_z^y [a+(x-z)+(d-x)-3(y-x)]^2\,dx$$
$$+ \int_y^d [a+(x-z)+(d-x)-3(x-y)]^2\,dx + \int_d^{1/2} [a+(x-z)+(x-d)-3(x-y)]^2\,dx$$
$$+ \int_{1/2}^{z+1/2} [a+(x-z)+(1-d-x)-3(x-y)]^2\,dx + \int_{z+1/2}^{1-d} \left[\begin{array}{c} a+(1+z-x)+ \\ (1-d-x)-3(x-y) \end{array}\right]^2 dx$$
$$+ \int_{1-d}^{y+1/2} [a+(1+z-x)+(x-1+d)-3(x-y)]^2\,dx + \int_{y+1/2}^{1} \left[\begin{array}{c} a+(1+z-x)+ \\ (x-1+d)-3(1+y-x) \end{array}\right]^2 dx$$
$$= 3y + \tfrac{7}{2}d - 6yz + 2z^2 + 4z^2d - 12z^2y - 5d^2 - 12dy + 12zy^2$$
$$+12d^2y + 4z^3 + \tfrac{4}{3}d^3 - \tfrac{5}{12} + a^2 - \tfrac{a}{2}$$

First Order Condition:

$$\tfrac{\partial}{\partial y}\Pi^{(3)}[y] = 3 - 6z - 12z^2 - 12d + 24yz + 12d^2 = 0$$

Second Order Condition:

$$\tfrac{\partial^2}{\partial y^2}\Pi^{(3)}[y] = 24z \leq 0$$

Remark: In light of this SOC, case 4 cannot possibly yield positive solutions.

Case 5: $0 \leq z \leq d \leq y \leq 1/2 \leq 1-d \leq z+1/2 \leq y+1/2 \leq 1$

Profit of outsider firm located at z:

$\Pi^{(3)}[z]\times 16 = \int_0^z [a+(d-x)+(y-x)-3(z-x)]^2\,dx + \int_z^d [a+(d-x)+(y-x)-3(x-z)]^2\,dx$
$+ \int_d^y [a+(x-d)+(y-x)-3(x-z)]^2\,dx + \int_y^{1/2} [a+(x-d)+(x-y)-3(x-z)]^2\,dx$
$+ \int_{1/2}^{1-d} [a+(1-d-x)+(x-y)-3(x-z)]^2\,dx + \int_{1-d}^{z+1/2} [a+(x-1+d)+(x-y)-3(x-z)]^2\,dx$
$+ \int_{z+1/2}^{y+1/2} [a+(x-1+d)+(x-y)-3(1+z-x)]^2\,dx + \int_{y+1/2}^{1} \left[\begin{array}{c} a+(x-1+d)+ \\ (1+y-x)-3(1+z-x) \end{array}\right]^2 dx$
$= \frac{5}{2}d - y + 3z - 12z^2y - 3d^2 + 4dy - 12dz + 4y^2 - 6yz + 12zd^2 +$
$12zy^2 + 8z^3 - \frac{4}{3}d^3 - 4y^2d - 4y^3 - \frac{1}{4} + a^2 - \frac{a}{2}$

First Order Condition:

$\frac{\partial}{\partial z}\Pi^{(3)}[z] = 3 - 24yz - 12d - 6y + 12d^2 + 12y^2 + 24z^2 = 0$

Second Order Condition:

$\frac{\partial^2}{\partial z^2}\Pi^{(3)}[z] = -24y + 48z \leq 0$, Solution is: $\left\{z \leq \frac{1}{2}y\right\}$

Profit of outsider firm located at y:

$\Pi^{(3)}[y]\times 16 = \int_0^z [a+(d-x)+(z-x)-3(y-x)]^2\,dx + \int_z^d [a+(d-x)+(x-z)-3(y-x)]^2\,dx$
$+ \int_d^y [a+(x-d)+(x-z)-3(y-x)]^2\,dx + \int_y^{1/2} [a+(x-d)+(x-z)-3(x-y)]^2\,dx$
$+ \int_{1/2}^{1-d} [a+(1-d-x)+(x-z)-3(x-y)]^2\,dx + \int_{1-d}^{z+1/2} [a+(x-1+d)+(x-z)-3(x-y)]^2\,dx$
$+ \int_{z+1/2}^{y+1/2} [a+(x-1+d)+(1-x+z)-3(x-y)]^2\,dx + \int_{y+1/2}^{1} \left[\begin{array}{c} a+(x-1+d)+ \\ (1+z-x)-3(1+y-x) \end{array}\right]^2 dx$
$= \frac{5}{2}d + 3y - z - 3d^2 - 6yz + 4z^2 - \frac{1}{4} - 12z^2y + 4dz - 12dy$
$-4zd^2 + 12zy^2 + \frac{8}{3}z^3 + 4d^3 + 12y^2d - 4y^3 + a^2 - \frac{a}{2}$

First Order Condition:

$\frac{\partial}{\partial y}\Pi^{(3)}[y] = 3 - 6z - 12z^2 - 12d + 24yz + 24dy - 12y^2 = 0$

Second Order Condition:

$\frac{\partial^2}{\partial y^2}\Pi^{(3)}[y] = 24z + 24d - 24y \leq 0$, Solution is: $\{z + d \leq y\}$

Profit of the merged firm

$\Pi^{(3)}_{merged}\times 16 = \int_0^z [a+(y-x)+(z-x)-3(d-x)]^2\,dx + \int_z^d [a+(y-x)+(x-z)-3(d-x)]^2\,dx$
$+ \int_d^y [a+(y-x)+(x-z)-3(x-d)]^2\,dx + \int_y^{1/2} [a+(x-y)+(x-z)-3(x-d)]^2\,dx$

$$+\int_{1/2}^{1-d}\left[a+(x-y)+(x-z)-3(1-d-x)\right]^2dx+\int_{1-d}^{z+1/2}\left[\begin{array}{c}a+(x-y)+(x-z)\\-3(x-1+d)\end{array}\right]^2dx$$

$$+\int_{z+1/2}^{y+1/2}\left[a+(x-y)+(1-x+z)-3(x-1+d)\right]^2dx+\int_{y+1/2}^{1}\left[\begin{array}{c}a+(1-x+y)+\\(1+z-x)-3(x-1+d)\end{array}\right]^2dx$$

$$=\tfrac{9}{2}d+3y+3z-3d^2-4y^2+2yz-4z^2+4z^2y-12dz-12dy+$$

$$12zd^2-4zy^2+\tfrac{8}{3}z^3+4d^3+12y^2d+\tfrac{4}{3}y^3-\tfrac{1}{2}a+a^2+6ad-12ad^2-\tfrac{11}{12}$$

First Order Condition:

$$\frac{\partial}{\partial d}\Pi^{(3)}_{merged}=\tfrac{9}{2}-6d-12z-12y+24dz+12d^2+12y^2+6a-24ad=0$$

Second Order Condition:

$$\frac{\partial^2}{\partial d^2}\Pi^{(3)}_{merged}=-6+24z+24d-24a\leq 0,\text{ Solution is: }\left\{d\leq\tfrac{1}{4}-z+a\right\}$$

We solve the simultaneous system of FOCs with Mathematica:

```
In[1]:= Reduce@
     8H9ê2L-6 d-12 z-12 y+24 d z+12 d^2+12 y^2+6 a-24 a d« 0,
      3-6 z-12 z^2-12 d+24 y z+24 d y-12 y^2« 0,
      3-24 y z-12 d-6 y+12 d^2+12 y^2+24 z^2« 0<,
     8z, y, d<D

    There is no rational solution to this system.
      Case 5 has no valid solution.
```

Case 6: $0\leq z\leq d\leq y\leq 1/2\leq z+1/2\leq 1-d\leq y+1/2\leq 1$

Profit of outsider firm located at z:

$$\Pi^{(3)}[z]\times 16=\int_0^z\left[a+(d-x)+(y-x)-3(z-x)\right]^2dx+\int_z^d\left[a+(d-x)+(y-x)-3(x-z)\right]^2dx$$

$$+\int_d^y\left[a+(x-d)+(y-x)-3(x-z)\right]^2dx+\int_y^{1/2}\left[a+(x-d)+(x-y)-3(x-z)\right]^2dx$$

$$+\int_{1/2}^{z+1/2}\left[a+(1-d-x)+(x-y)-3(x-z)\right]^2dx+\int_{z+1/2}^{1-d}\left[\begin{array}{c}a+(1-d-x)+\\(x-y)-3(1+z-x)\end{array}\right]^2dx$$

$$+\int_{1-d}^{y+1/2}\left[a+(x-1+d)+(x-y)-3(1+z-x)\right]^2dx+\int_{y+1/2}^{1}\left[\begin{array}{c}a+(x-1+d)+\\(1+y-x)-3(1+z-x)\end{array}\right]^2dx$$

$$=-\tfrac{1}{2}d-y-12z^2d-12z^2y+3d^2+4dy+4y^2-6yz+12zy^2+$$

$$4z^3+6z^2-\tfrac{16}{3}d^3-4y^2d-4y^3+\tfrac{1}{4}+a^2-\tfrac{a}{2}$$

First Order Condition:

$$\frac{\partial}{\partial z}\Pi^{(3)}[z]=-24dz-24yz-6y+12y^2+12z^2+12z=0$$

Second Order Condition:

$\frac{\partial^2}{\partial z^2}\Pi^{(3)}[z] = -24d - 24y + 24z + 12 \leq 0$, Solution is: $\left\{z \leq d + y - \frac{1}{2}\right\}$

Profit of outsider firm located at y:

$$\Pi^{(3)}[y]\times 16 = \int_0^z [a + (d-x) + (z-x) - 3(y-x)]^2\,dx + \int_z^d \left[\begin{array}{c} a + (d-x) + \\ (x-z) - 3(y-x) \end{array}\right]^2 dx$$
$$+ \int_d^y [a + (x-d) + (x-z) - 3(y-x)]^2\,dx + \int_y^{1/2} [a + (x-d) + (x-z) - 3(x-y)]^2\,dx$$
$$+ \int_{1/2}^{z+1/2} [a + (1-d-x) + (x-z) - 3(x-y)]^2\,dx + \int_{z+1/2}^{1-d} \left[\begin{array}{c} a + (1-d-x) + \\ (1-x+z) - 3(x-y) \end{array}\right]^2 dx$$
$$+ \int_{1-d}^{y+1/2} \left[\begin{array}{c} a + (x-1+d) + \\ (1-x+z) - 3(x-y) \end{array}\right]^2 dx + \int_{y+1/2}^{1} \left[\begin{array}{c} a + (x-1+d) + \\ (1+z-x) - 3(1+y-x) \end{array}\right]^2 dx$$
$$= \tfrac{7}{2}d + 3y - 6yz + 2z^2 + 4z^2d - 12z^2y - 5d^2 - 12dy + 12zy^2 +$$
$$12y^2d + 4z^3 + \tfrac{16}{3}d^3 - 4y^3 - \tfrac{5}{12} + a^2 - \tfrac{a}{2}$$

First Order Condition:

$\frac{\partial}{\partial y}\Pi^{(3)}[y] = 3 - 6z - 12z^2 - 12d + 24yz + 24dy - 12y^2 = 0$

Second Order Condition:

$\frac{\partial^2}{\partial y^2}\Pi^{(3)}[y] = 24z + 24d - 24y \leq 0$, Solution is: $\{z + d \leq y\}$

Profit of the merged firm

$$\Pi^{(3)}_{merged}\times 16 = \int_0^z (a + (y-x) + (z-x) - 3(d-x))^2 dx + \int_z^d \left(\begin{array}{c} a + (y-x) + \\ (x-z) - 3(d-x) \end{array}\right)^2 dx$$
$$+ \int_d^y (a + (y-x) + (x-z) - 3(x-d))^2 dx + \int_y^{1/2} (a + (x-y) + (x-z) - 3(x-d))^2 dx$$
$$+ \int_{1/2}^{z+1/2} \left(\begin{array}{c} a + (x-y) + \\ (x-z) - 3(1-d-x) \end{array}\right)^2 dx + \int_{z+1/2}^{1-d} \left(\begin{array}{c} a + (x-y) + \\ (1-x+z) - 3(1-d-x) \end{array}\right)^2 dx$$
$$+ \int_{1-d}^{y+1/2} \left(\begin{array}{c} a + (x-y) + \\ (1-x+z) - 3(x-1+d) \end{array}\right)^2 dx + \int_{y+1/2}^{1} \left(\begin{array}{c} a + (1+y-x) + \\ (1+z-x) - 3(x-1+d) \end{array}\right)^2 dx$$
$$= \tfrac{3}{2}d + 3y - 4y^2 + 2yz + 2z^2 - 12z^2d + 4z^2y + 3d^2 - 12dy - 4zy^2 + 12y^2d - \tfrac{4}{3}z^3 + \tfrac{4}{3}y^3 -$$
$$\tfrac{5}{12} - \tfrac{1}{2}a + a^2 + 6ad - 12ad^2$$

First Order Condition:

$\frac{\partial}{\partial d}\Pi^{(3)}_{merged} = \frac{3}{2} - 12z^2 + 6d - 12y + 12y^2 + 6a - 24ad = 0$

Second Order Condition:

$\frac{\partial^2}{\partial d^2}\Pi^{(3)}_{merged} = 6 - 24a \leq 0$

We solve the simultaneous system of FOCs with Mathematica:

```
In[1]:= Reduce@
        8H3ê2L-12 z^2+6 d-12 y+12 y^2+6 a-24 a d« 0,
         3-6 z-12 z^2-12 d+24 y z+24 d y-12 y^2« 0,
         -24 d z-24 y z-6 y+12 y^2+12 z^2+12 z« 0<,
        8z, y, d<D

Out[1]= a == 1/4 && d == 1/4 && z == 1/2 H-1 + 2 yL »»
        a == 1/4 && y == 1/2 && z == 0 »»
        d == 1/4 && z == 1/2 H-1 + 2 yL && -1 + 4 a ≠ 0
```

The solution satifying all conditions is $\boxed{z = 0, y = 1/2, d = 1/4}$

Case 7: $0 \leq z \leq d \leq y - 1/2 \leq 1/2 \leq z + 1/2 \leq 1 - d \leq y \leq 1$

Profit of outsider firm located at z:

$$\Pi^{(3)}[z] \times 16 = \int_0^z \begin{bmatrix} a + (d-x) + \\ (1-y+x) - 3(z-x) \end{bmatrix}^2 dx + \int_z^d \begin{bmatrix} a + (d-x) + \\ (1-y+x) - 3(x-z) \end{bmatrix}^2 dx$$

$$+ \int_d^{y-1/2} [a + (x-d) + (1-y+x) - 3(x-z)]^2 dx + \int_{y-1/2}^{1/2} [a + (x-d) + (y-x) - 3(x-z)]^2 dx$$

$$+ \int_{1/2}^{z+1/2} [a + (1-d-x) + (y-x) - 3(x-z)]^2 dx + \int_{z+1/2}^{1-d} \begin{bmatrix} a + (1-d-x) \\ +(y-x) - 3(1+z-x) \end{bmatrix}^2 dx$$

$$+ \int_{1-d}^{y} [a + (x-1+d) + (y-x) - 3(1+z-x)]^2 dx + \int_y^1 \begin{bmatrix} a + (x-1+d) + \\ (x-y) - 3(1+z-x) \end{bmatrix}^2 dx$$

$$= \tfrac{9}{2}d + 8y - 6z + d^2 - 10y^2 + 18yz - 6z^2 - 12z^2 d + 12z^2 y$$

$$-8dy - 12zy^2 - 4z^3 - \tfrac{8}{3}d^3 + 4y^2 d + yr^3 - \tfrac{23}{12} + a^2 - \tfrac{a}{2}$$

First Order Condition:

$$\tfrac{\partial}{\partial z}\Pi^{(3)}[z] = -6 + 18y - 12z - 24dz + 24yz - 12y^2 - 12z^2 = 0$$

Second Order Condition:

$\tfrac{\partial^2}{\partial z^2}\Pi^{(3)}[z] = -12 - 24d + 24y - 24z \leq 0$, Solution is: $\left\{y - \tfrac{1}{2} - d \leq z\right\}$

Profit of outsider firm located at y:

$$\Pi^{(3)}[y] \times 16 = \int_0^z \begin{bmatrix} a + (d-x) + \\ (z-x) - 3(1-y+x) \end{bmatrix}^2 dx + \int_z^d \begin{bmatrix} a + (d-x) \\ +(x-z) - 3(1-y+x) \end{bmatrix}^2 dx$$

$$+ \int_d^{y-1/2} \begin{bmatrix} a + (x-d) + (x-z) \\ -3(1-y+x) \end{bmatrix}^2 dx + \int_{y-1/2}^{1/2} [a + (x-d) + (x-z) - 3(y-x)]^2 dx$$

$$+\int_{1/2}^{z+1/2}\left[a+(1-d-x)+(x-z)-3(y-x)\right]^2dx+\int_{z+1/2}^{1-d}\left[\begin{array}{c}a+(1-d-x)+\\(1-x+z)-3(y-x)\end{array}\right]^2dx$$

$$+\int_{1-d}^{y}\left[a+(x-1+d)+(1+z-x)-3(y-x)\right]^2dx+\int_{y}^{1}\left[\begin{array}{c}a+(x-1+d)+\\(1+z-x)-3(x-y)\end{array}\right]^2dx$$

$$=-\tfrac{23}{2}d-6z+d^2-6y^2+18yz-10z^2+4z^2d+12z^2y+24dy-12zy^2-4z^3-\tfrac{8}{3}d^3-12y^2d+4y^3+\tfrac{25}{12}+a^2-\tfrac{a}{2}$$

First Order Condition:

$\frac{\partial}{\partial y}\Pi^{(3)}[y]=-12y+18z+12z^2+24d-24yz-24dy+12y^2=0$

Second Order Condition:

$\frac{\partial^2}{\partial y^2}\Pi^{(3)}[y]=-12-24d+24y-24z\leq 0$, Solution is: $\left\{y\leq\frac{1}{2}+d+z\right\}$

Profit of the merged firm

$$\Pi^{(3)}_{merged}\times 16=\int_0^z\left[\begin{array}{c}a+(1-y+x)+\\(z-x)-3(d-x)\end{array}\right]^2dx+\int_z^d\left[\begin{array}{c}a+(1-y+x)+\\(x-z)-3(d-x)\end{array}\right]^2dx$$

$$+\int_d^{y-1/2}\left[\begin{array}{c}a+(1-y+x)+\\(x-z)-3(x-d)\end{array}\right]^2dx+\int_{y-1/2}^{1/2}\left[\begin{array}{c}a+(y-x)+\\(x-z)-3(x-d)\end{array}\right]^2dx$$

$$+\int_{1/2}^{z+1/2}\left[\begin{array}{c}a+(y-x)+(x-z)\\-3(1-d-x)\end{array}\right]^2dx+\int_{z+1/2}^{1-d}\left[\begin{array}{c}a+(y-x)+\\(1-x+z)-3(1-d-x)\end{array}\right]^2dx$$

$$+\int_{1-d}^{y}\left[\begin{array}{c}a+(y-x)+(1+z-x)\\-3(x-1+d)\end{array}\right]^2dx+\int_{y}^{1}\left[\begin{array}{c}a+(x-y)+\\(1+z-x)-3(x-1+d)\end{array}\right]^2dx$$

$$=-\tfrac{27}{2}d-8y+2z+9d^2+6y^2-6yz+6z^2+\tfrac{41}{12}-12z^2d-4z^2y+24dy$$

$$+4zy^2+\tfrac{4}{3}z^3-8d^3-12y^2d-\tfrac{4}{3}y^3-\tfrac{1}{2}a+a^2+6ad-12ad^2$$

First Order Condition:

$\frac{\partial}{\partial d}\Pi^{(3)}_{merged}=-\frac{27}{2}+18d-12z^2+24y-24d^2-12y^2+6a-24ad=0$

Second Order Condition:

$\frac{\partial^2}{\partial d^2}\Pi^{(3)}_{merged}=18-48d-24a\leq 0$, Solution is: $\left\{\frac{3}{8}-\frac{1}{2}a\leq d\right\}$

We solve the simultaneous system of FOCs with Mathematica:

```
In[2]:= Reduce@
        8-HH27L ê 2L + 18  d - 12  z^2 + 24  y - 24  d^2 - 12  y^2 +
           6  a - 24  a  d « 0,
         -12  y + 18  z + 12  z^2 + 24  d - 24  y  z - 24  d  y +
           12  y^2 « 0,
         -6 + 18  y - 12  z - 24  d  z + 24  y  z - 12  y^2 - 12  z^2 «
          0<, 8z, y, d<D
```

Out[2]= $d == \frac{1}{4}$ && $y == \frac{3}{4}$ && $z == -\frac{1}{4}$ »»

$d == \frac{1}{4}$ && $y == \frac{3}{4}$ && $z == \frac{1}{4}$ »» $d == \frac{1}{4}$ && $y == \frac{5}{4}$ && $z == \frac{1}{4}$ »»

$d == \frac{1}{20}$ H13 - 16 aL && $y == \frac{1}{20}$ H19 - 8 aL && $z == \frac{1}{20}$ H1 + 8 aL »»

$d == \frac{1}{8}\left(3 - 4a - \sqrt{5 - 8a + 16a^2}\right)$ && $y == 1$ && $z == 0$ »»

$d == \frac{1}{8}\left(3 - 4a + \sqrt{5 - 8a + 16a^2}\right)$ && $y == 1$ && $z == 0$

The unique solution is $\boxed{z = 1/4, y = /4, d = 1/4}$

Case 8: $0 \leq y - 1/2 \leq d \leq z \leq 1/2 \leq y \leq 1 - d \leq z + 1/2 \leq 1$

Profit of outsider firm located at z:

$$\Pi^{(3)}[z] \times 16 = \int_0^{y-1/2} \left[\begin{array}{c} a + (1 - y + x) + \\ (d - x) - 3(z - x) \end{array} \right]^2 dx + \int_{y-1/2}^{d} \left[\begin{array}{c} a + (y - x) + \\ (d - x) - 3(z - x) \end{array} \right]^2 dx$$

$$+ \int_d^z [a + (y - x) + (x - d) - 3(z - x)]^2 dx + \int_z^{1/2} [a + (y - x) + (x - d) - 3(x - z)]^2 dx$$

$$+ \int_{1/2}^{y} [a + (y - x) + (1 - d - x) - 3(x - z)]^2 dx + \int_y^{1-d} [a + (x - y) + (1 - d - x) - 3(x - z)]^2 dx$$

$$+ \int_{1-d}^{z+1/2} [a + (x - y) + (x - 1 + d) - 3(x - z)]^2 dx + \int_{z+1/2}^{1} \left[\begin{array}{c} a + (x - y) + \\ (x - 1 + d) - 3(1 - x + z) \end{array} \right]^2 dx$$

$$= 3z + \tfrac{5}{2}d - y + 4y^2 - 6zy + 4dy - \tfrac{1}{4} - 4dy^2 + 12zy^2 - 3d^2 - 12dz - 12z^2y - 4y^3 + \tfrac{8}{3}d^3 +$$

$$12z^2d + 4z^3 + a^2 - \tfrac{a}{2}$$

First Order Condition:

$$\tfrac{\partial}{\partial z}\Pi^{(3)}[z] = 3 - 6y + 12y^2 - 12d - 24zy + 24dz + 12z^2 = 0$$

Second Order Condition:

$$\tfrac{\partial^2}{\partial z^2}\Pi^{(3)}[z] = 24z + 24d - 24y \leq 0$$

Profit of outsider firm located at y:

$$\Pi^{(3)}[y] \times 16 = \int_0^{y-1/2} \left[\begin{array}{c} a + (z - x) + (d - x) \\ -3(1 - y + x) \end{array} \right]^2 dx + \int_{y-1/2}^{d} \left[\begin{array}{c} a + (z - x) + \\ (d - x) - 3(y - x) \end{array} \right]^2 dx$$

$$+ \int_d^z [a + (z - x) + (x - d) - 3(y - x)]^2 dx + \int_z^{1/2} [a + (x - z) + (x - d) - 3(y - x)]^2 dx$$

$$+\int_{1/2}^{y}\left[a+(x-z)+(1-d-x)-3(y-x)\right]^2dx+\int_{y}^{1-d}\left[\begin{array}{c}a+(x-z)+\\(1-d-x)-3(x-y)\end{array}\right]^2dx$$

$$+\int_{1-d}^{z+1/2}\left[a+(x-z)+(x-1+d)-3(x-y)\right]^2dx+\int_{z+1/2}^{1}\left[\begin{array}{c}a+(1+z-x)+\\(x-1+d)-3(x-y)\end{array}\right]^2dx$$

$$=-z+\tfrac{5}{2}d+3y+12zy^2-6zy+12dy^2-12dy+4z^2+4zd-3d^2-12z^2y-4y^3+\tfrac{8}{3}d^3-4z^2d-\tfrac{1}{4}+4z^3+a^2-\tfrac{a}{2}$$

First Order Condition:

$\frac{\partial}{\partial y}\Pi^{(3)}[y]=3+24zy-6z+24dy-12d-12z^2-12y^2=0$

Second Order Condition:

$\frac{\partial^2}{\partial y^2}\Pi^{(3)}[y]=24z+24d-24y\leq 0$, Solution is: $\{z+d\leq y\}$

Profit of the merged firm:

$$\Pi^{(3)}_{merged}\times 16=\int_{0}^{y-1/2}\left[\begin{array}{c}a+(1-y+x)+\\(z-x)-3(d-x)\end{array}\right]^2dx+\int_{y-1/2}^{d}\left[\begin{array}{c}a+(y-x)+\\(z-x)-3(d-x)\end{array}\right]^2dx$$

$$+\int_{d}^{z}\left[a+(y-x)+(z-x)-3(x-d)\right]^2dx+\int_{z}^{1/2}\left[a+(y-x)+(x-z)-3(x-d)\right]^2dx$$

$$+\int_{1/2}^{y}\left[\begin{array}{c}a+(y-x)+(x-z)\\-3(1-d-x)\end{array}\right]^2dx+\int_{y}^{1-d}\left[\begin{array}{c}a+(x-y)+\\(x-z)-3(1-d-x)\end{array}\right]^2dx$$

$$+\int_{1-d}^{z+1/2}\left[\begin{array}{c}a+(x-y)+(x-z)\\-3(x-1+d)\end{array}\right]^2dx+\int_{z+1/2}^{1}\left[\begin{array}{c}a+(x-y)+(1+z-x)\\-3(x-1+d)\end{array}\right]^2dx$$

$$=3z+\tfrac{9}{2}d+3y-4y^2+2zy-12dy-4z^2+12dy^2-4zy^2-3d^2-12dz+4z^2y$$

$$+\tfrac{4}{3}y^3+8d^3+12z^2d-\tfrac{4}{3}z^3-\tfrac{1}{2}a-\tfrac{11}{12}+a^2+6ad-12ad^2$$

First Order Condition:

$\frac{\partial}{\partial d}\Pi^{(3)}_{merged}=\frac{9}{2}-12y+12y^2-6d-12z+24d^2+12z^2+6a-24ad=0$

Second Order Condition:

$\frac{\partial^2}{\partial d^2}\Pi^{(3)}_{merged}=-6+48d-24a\leq 0$, Solution is: $\left\{d\leq\frac{1}{8}+\frac{1}{2}a\right\}$

We solve the simultaneous system of FOCs with Mathematica:

```
In[3]:= Reduce@
        8H9ê2L-12 y+12 y^2-6 d-12 z+24 d^2+12 z^2+6 a-24 a d « 0,
         3-6 y+12 y^2-12 d-24 z y+24 d z+12 z^2 « 0,
         3+24 z y-6 z+24 d y-12 d-12 z^2-12 y^2 « 0<,
        8z, y, d<D
```

$$\text{Out[3]= } d == \frac{1}{4} \;\&\&\; y == \frac{1}{4} \;\&\&\; z == \frac{1}{4} \;\text{»»}$$

$$d == \frac{1}{4} \;\&\&\; y == \frac{3}{4} \;\&\&\; z == \frac{1}{4} \;\text{»» } d == \frac{1}{4} \;\&\&\; y == \frac{3}{4} \;\&\&\; z == \frac{3}{4} \;\text{»»}$$

$$d == \frac{1}{20}\left(-3+16a\right) \;\&\&\; y == \frac{1}{20}\left(11+8a\right) \;\&\&\; z == \frac{1}{20}\left(9-8a\right) \;\text{»»}$$

$$d == \frac{1}{8}\left(1+4a-\sqrt{5-8a+16a^2}\right) \;\&\&\; y == \frac{1}{2} \;\&\&\; z == \frac{1}{2} \;\text{»»}$$

$$d == \frac{1}{8}\left(1+4a+\sqrt{5-8a+16a^2}\right) \;\&\&\; y == \frac{1}{2} \;\&\&\; z == \frac{1}{2}$$

The unique solution is $\boxed{z = 1/4, y = 3/4, d = 1/4}$

Case 9: $0 \leq z \leq y - 1/2 \leq d \leq 1/2 \leq 1 - d \leq z + 1/2 \leq y \leq 1$

Profit of outsider firm located at z:

$$\Pi^{(3)}[z]\times 16 = \int_0^z \begin{bmatrix} a + (d-x) + (1-y+x) \\ -3(z-x) \end{bmatrix}^2 dx + \int_z^{y-1/2} \begin{bmatrix} a + (d-x) + \\ (1-y+x) - 3(x-z) \end{bmatrix}^2 dx$$
$$+ \int_{y-1/2}^{d} [a + (d-x) + (y-x) - 3(x-z)]^2\, dx + \int_d^{1/2} [a + (x-d) + (y-x) - 3(x-z)]^2\, dx$$
$$+ \int_{1/2}^{1-d} [a + (1-d-x) + (y-x) - 3(x-z)]^2\, dx + \int_{1-d}^{z+1/2} [a + (x-1+d) + (y-x) - 3(x-z)]^2\, dx$$
$$+ \int_{z+1/2}^{y} \begin{bmatrix} a + (x-1+d) + \\ (y-x) - 3(1+z-x) \end{bmatrix}^2 dx + \int_{z+1/2}^{y} \begin{bmatrix} a + (x-1+d) + \\ (y-x) - 3(1+z-x) \end{bmatrix}^2 dx +$$
$$= 4d^2y + \tfrac{13}{2}d + \tfrac{16}{3}y^3 - 12z^2 + 12zd^2 - \tfrac{31}{12} - 12zy^2 - 3z + 9y - 12y^2 + 18yz + 12z^2y -$$
$$7d^2 - 4dy - 12dz + a^2 - \tfrac{a}{2}$$

First Order Condition:

$$\frac{\partial}{\partial z}\Pi^{(3)}[z] = -24z + 12d^2 - 12y^2 - 3 + 18y + 24yz - 12d = 0$$

Second Order Condition:

$$\frac{\partial^2}{\partial z^2}\Pi^{(3)}[z] = -24 + 24r \leq 0$$

Profit of outsider firm located at y:

$$\Pi^{(3)}[y]\times 16 = \int_0^z \begin{bmatrix} a + (d-x) + (z-x) \\ -3(1-y+x) \end{bmatrix}^2 dx + \int_z^{y-1/2} \begin{bmatrix} a + (d-x) + \\ (x-z) - 3(1-y+x) \end{bmatrix}^2 dx$$
$$+ \int_{y-1/2}^{d} [a + (d-x) + (x-z) - 3(y-x)]^2\, dx + \int_d^{1/2} [a + (x-d) + (x-z) - 3(y-x)]^2\, dx$$
$$+ \int_{1/2}^{1-d} [a + (1-d-x) + (x-z) - 3(y-x)]^2\, dx + \int_{1-d}^{z+1/2} [a + (x-1+d) + (x-z) - 3(z-x)]^2\, dx$$

$$+\int_{z+1/2}^{y}\left[\begin{array}{c}a+(x-1+d)+\\(1+z-x)-3(y-x)\end{array}\right]^2dx+\int_{y}^{1}\left[\begin{array}{c}a+(x-1+d)+\\(1-x+z)-3(x-r)\end{array}\right]^2dx$$

$$=-12d^2y-\tfrac{19}{2}d-\tfrac{16}{3}z^3-8z^2-4zd^2+\tfrac{11}{4}-12zy^2-7z-3y+18yz+12z^2y+9d^2+12dr+4dz+a^2-\tfrac{a}{2}$$

First Order Condition:

$$\tfrac{\partial}{\partial y}\Pi^{(3)}[y]=-12d^2-24yz-3+18z+12z^2+12d=0$$

Second Order Condition:

$$\tfrac{\partial^2}{\partial y^2}\Pi^{(3)}[y]=-24p\leq 0$$

Profit of the merged firm:

$$\Pi^{(3)}_{merged}\times 16=\int_0^z\left[\begin{array}{c}a+(1-y+x)+(z-x)\\-3(d-x)\end{array}\right]^2dx+\int_z^{y-1/2}\left[\begin{array}{c}a+(1-y+x)+\\(x-z)-3(d-x)\end{array}\right]^2dx$$

$$+\int_{y-1/2}^{d}[a+(y-x)+(x-z)-3(d-x)]^2dx+\int_d^{1/2}[a+(y-x)+(x-z)-3(x-d)]^2dx$$

$$+\int_{1/2}^{1-d}[a+(y-x)+(x-z)-3(1-d-x)]^2dx+\int_{1-d}^{z+1/2}[a+(y-x)+(x-z)-3(x-1+d)]^2dx$$

$$+\int_{p+1/2}^{y}\left[\begin{array}{c}a+(y-x)+(1+z-x)\\-3(x-1+d)\end{array}\right]^2dx+\int_y^1\left[\begin{array}{c}a+(x-y)+(1-x+z)\\-3(x-1+d)\end{array}\right]^2dx$$

$$=-12d^2y-\tfrac{15}{2}d-\tfrac{16}{3}y^3+\tfrac{16}{3}z^3+12zd^2-\tfrac{1}{2}a+a^2+6ad-12ad^2+4zy^2+5z-11y$$

$$+12y^2-6yz+\tfrac{41}{12}-4z^2y+9d^2+12dy-12dz$$

First Order Condition:

$$\tfrac{\partial}{\partial d}\Pi^{(3)}_{merged}=-24dy-\tfrac{15}{2}+24dz+6a-24ad+18d+12y-12z=0$$

Second Order Condition:

$$\tfrac{\partial^2}{\partial d^2}\Pi^{(3)}_{merged}=-24r+24p-24a+18\leq 0$$

We solve the simultaneous system of FOCs with Mathematica:

```
In[4]:= Simplify@Reduce@8-24 z+12 d^2-12 y^2-3+18 y+24 y z-12 d « 0,
        -12 d^2-24 y z-3+18 z+12 z^2+12 d « 0,
        -24 d y-HH15Lê2L+24 d z+6 a-24 a d+18 d+12 y-12 z « 0<, 8z, y, d<DD
```

The only rational candidates are

```
a == 1/4 && y == (-3/2 + 3 d + 1/2 e^Sqrt[-3 + 16 d - 16 d^2] - d e^Sqrt[-3 + 16 d - 16 d^2])/(-2 + 4 d) && z == 1/4 (1 - Sqrt[-3 + 16 d - 16 d^2]) »
a == 1/4 && y == (-3/2 + 3 d - 1/2 è^Sqrt[-3 + 16 d - 16 d^2] + d è^Sqrt[-3 + 16 d - 16 d^2])/(-2 + 4 d) && z == 1/4 (1 + Sqrt[-3 + 16 d - 16 d^2]) »
d == 1/4 && y == 3/4 && z == 1/4 && -1 + 4 a ≠ 0 »
```

and it is straightforward to obtain that the unique solution is $\boxed{z=1/4, y=3/4, d=1/4}$

Case 10: $0 \leq z \leq y - 1/2 \leq d \leq 1/2 \leq z + 1/2 \leq y \leq 1 - d \leq 1$

Profit of outsider firm located at z:

$$\Pi^{(3)}[z] \times 16 = \int_0^z \left[\begin{array}{c} a + (1 - y + x) + \\ (d - x) - 3(z - x) \end{array} \right]^2 dx + \int_z^{y-1/2} \left[\begin{array}{c} a + (1 - y + x) + \\ (d - x) - 3(x - z) \end{array} \right]^2 dx$$
$$+ \int_{y-1/2}^{d} [a + (y - x) + (d - x) - 3(x - z)]^2 dx + \int_d^{1/2} [a + (y - x) + (x - d) - 3(x - z)]^2 dx$$
$$+ \int_{1/2}^{z+1/2} \left[\begin{array}{c} a + (y - x) + (1 - d - x) \\ -3(x - z) \end{array} \right]^2 dx + \int_{z+1/2}^{y} \left[\begin{array}{c} a + (y - x) + (1 - d - x) \\ -3(1 + z - x) \end{array} \right]^2 dx$$
$$+ \int_y^{1-d} \left[\begin{array}{c} a + (x - y) + (1 - d - x) \\ -3(1 + z - x) \end{array} \right]^2 dx + \int_{1-d}^{1} \left[\begin{array}{c} a + (x - y) + (x - 1 + d) \\ -3(1 + z - x) \end{array} \right]^2 dx$$
$$= 5y - \tfrac{1}{2}d - 6z - 12z^2 d + 12z^2 y - 4z^3 - 6z^2 + 18zy + 3d^2 + 4dy - 8y^2 - 12zy^2 - 4dy^2 + 4y^3 - \tfrac{3}{4} - \tfrac{16}{3}d^3 + a^2 - \tfrac{a}{2}$$

First Order Condition:

$\frac{\partial}{\partial z}\Pi^{(3)}[z] = -6 - 24zd + 24zy - 12z^2 - 12z + 18y - 12y^2 = 0$

Second Order Condition:

$\frac{\partial^2}{\partial z^2}\Pi^{(3)}[z] = 24y - 24d - 24z - 12 \leq 0$, Solution is: $\left\{y - d - \frac{1}{2} \leq z\right\}$

Profit of outsider firm located at y:

$$\Pi^{(3)}[y] \times 16 = \int_0^z \left[\begin{array}{c} a + (z - x) + (d - x) \\ -3(1 - y + x) \end{array} \right]^2 dx + \int_z^{y-1/2} \left[\begin{array}{c} a + (x - z) + (d - x) \\ -3(1 - y + x) \end{array} \right]^2 dx$$
$$+ \int_{y-1/2}^{d} [a + (x - z) + (d - x) - 3(y - x)]^2 dx + \int_d^{1/2} [a + (x - z) + (x - d) - 3(y - x)]^2 dx$$
$$+ \int_{1/2}^{z+1/2} \left[\begin{array}{c} a + (x - z) + (1 - d - x) \\ -3(y - x) \end{array} \right]^2 dx + \int_{z+1/2}^{y} \left[\begin{array}{c} a + (1 + z - x) + (1 - d - x) \\ -3(y - x) \end{array} \right]^2 dx$$
$$+ \int_y^{1-d} \left[\begin{array}{c} a + (1 - x + z) + (1 - d - x) \\ -3(x - y) \end{array} \right]^2 dx + \int_{1-d}^{1} \left[\begin{array}{c} a + (1 - x + z) + (x - 1 + d) \\ -3(x - y) \end{array} \right]^2 dx$$
$$= 9y + \tfrac{7}{2}d - 6z + 4z^2 d + 12z^2 y - 4z^3 - 10z^2 + 18zy - 5d^2 - 12dy - 12y^2 - 12zy^2 + 12dy^2 + 4y^3 + \tfrac{16}{3}d^3 - \tfrac{17}{12} + a^2 - \tfrac{a}{2}$$

First Order Condition:

$\frac{\partial}{\partial y}\Pi^{(3)}[y] = 9 + 12z^2 + 18z - 12d - 24y - 24zy + 24dy + 12y^2 = 0$

Second Order Condition:

$\frac{\partial^2}{\partial y^2}\Pi^{(3)}[y] = -24 - 24z + 24d + 24y \leq 0$, Solution is: $\{y \leq 1 + z - d\}$

Profit of the merged firm:

$$\Pi^{(3)}_{merged}\times 16 = \int_0^z \left[\begin{array}{c} a+(z-x)+ \\ (1-y+x)-3(d-x)\end{array}\right]^2 dx + \int_z^{y-1/2} \left[\begin{array}{c} a+(x-z)+ \\ (1-y+x)-3(d-x)\end{array}\right]^2 dx$$
$$+ \int_{y-1/2}^{d} [a+(x-z)+(y-x)-3(d-x)]^2\, dx + \int_d^{1/2} [a+(x-z)+(y-x)-3(x-d)]^2\, dx$$
$$+ \int_{1/2}^{z+1/2} \left[\begin{array}{c} a+(x-z)+ \\ (y-x)-3(1-d-x)\end{array}\right]^2 dx + \int_{z+1/2}^{y} \left[\begin{array}{c} a+(1+z-x)+ \\ (y-x)-3(1-d-x)\end{array}\right]^2 dx$$
$$+ \int_{y}^{1-d} \left[\begin{array}{c} a+(1-x+z)+ \\ (x-y)-3(1-d-x)\end{array}\right]^2 dx + \int_{1-d}^{1} \left[\begin{array}{c} a+(1-x+z)+ \\ (x-y)-3(x-1+d)\end{array}\right]^2 dx$$
$$= y+\tfrac{3}{2}d+2z-12z^2d-4z^2y+\tfrac{4}{3}z^3+6z^2-6zy+3d^2-12dy+4zy^2+12dy^2-\tfrac{4}{3}y^3-$$
$$\tfrac{1}{2}a+a^2+6ad-12ad^2-\tfrac{1}{12}$$

First Order Condition:

$$\tfrac{\partial}{\partial d}\Pi^{(3)}_{merged} = \tfrac{3}{2}-12z^2+6d-12y+12y^2+6a-24ad=0$$

Second Order Condition:

$$\tfrac{\partial^2}{\partial d^2}\Pi^{(3)}_{merged} = 6-24a\leq 0$$

We solve the simultaneous system of FOCs with Mathematica:

```
In[5]:= Reduce@8H3ê2L-12 z^2+6 d-12 y+12 y^2+6 a-24 a d« 0,
        9+12 z^2+18 z-12 d-24 y-24 z y+24 d y+12 y^2« 0,
        -6-24 z d+24 z y-12 z^2-12 z+18 y-12 y^2« 0<,
       8z, y, d<D

Out[5]= a == 1/4 && d == 1/4 && z == 1/2 H-1 + 2 yL »»
        a == 1/4 && y == 1/2 && z == 0 »» d == 1/4 && z == 1/2 H-1 + 2 yL && -1 + 4 a ≠ 0
```

From which the only solution is $\boxed{z=0, y=1/2, d=1/4}$

Case 11: $0\leq y-1/2\leq z\leq d\leq 1/2\leq y\leq 1-d\leq z+1/2\leq 1$

Profit of firm located at z:

$$\Pi^{(3)}[z]\times 16 = \int_0^{y-1/2} \left[\begin{array}{c} a+(1-y+x)+ \\ (d-x)-3(z-x)\end{array}\right]^2 dx + \int_{y-1/2}^{z} \left[\begin{array}{c} a+(y-x)+ \\ (d-x)-3(z-x)\end{array}\right]^2 dx$$
$$+ \int_z^d [a+(y-x)+(d-x)-3(x-z)]^2\, dx + \int_d^{1/2} [a+(y-x)+(x-d)-3(x-z)]^2\, dx$$
$$+ \int_{1/2}^{y} \left[\begin{array}{c} a+(y-x)+(1-d-x) \\ -3(x-z)\end{array}\right]^2 dx + \int_{y}^{1-d} \left[\begin{array}{c} a+(x-y)+(1-d-x) \\ -3(x-z)\end{array}\right]^2 dx$$

$$+\int_{1-d}^{z+1/2}\begin{bmatrix} a+(x-y)+(x-1+d) \\ -3(x-z)\end{bmatrix}^2 dx+\int_{z+1/2}^{1}\begin{bmatrix} a+(x-y)+(x-1+d) \\ -3(1+z-x)\end{bmatrix}^2 dx$$

$$=\tfrac{5}{2}d-y+3z-12dz+4y^2-6yz+12d^2z-\tfrac{4}{3}d^3-\tfrac{1}{4}-12z^2y-3d^2+4dy+12zy^2-4y^2d+8z^3-4y^3+a^2-\tfrac{a}{2}$$

First Order Condition:

$\frac{\partial}{\partial z}\Pi^{(3)}[z]=3-12d-6y+12d^2-24yz+12y^2+24z^2=0$

Second Order Condition:

$\frac{\partial^2}{\partial z^2}\Pi^{(3)}[z]=-24r+48p\leq 0$, Solution is: $\{z\leq\frac{1}{2}y\}$

Profit of firm located at y:

$$\Pi^{(3)}[y]\times 16=\int_0^{y-1/2}\begin{bmatrix} a+(z-x)+ \\ (d-x)-3(1-y+x)\end{bmatrix}^2 dx+\int_{y-1/2}^{z}\begin{bmatrix} a+(z-x)+ \\ (d-x)-3(y-x)\end{bmatrix}^2 dx$$

$$+\int_z^d[a+(x-z)+(d-x)-3(y-x)]^2\,dx+\int_d^{1/2}[a+(x-z)+(x-d)-3(y-x)]^2\,dx$$

$$+\int_{1/2}^{y}[a+(x-z)+(1-d-x)-3(y-x)]^2\,dx+\int_y^{1-d}[a+(x-z)+(1-d-x)-3(x-y)]^2\,dx$$

$$+\int_{1-d}^{z+1/2}\begin{bmatrix} a+(x-z)+ \\ (x-1+d)-3(x-y)\end{bmatrix}^2 dx+\int_{z+1/2}^{1}\begin{bmatrix} a+(1-x+z)+ \\ (x-1+d)-3(x-y)\end{bmatrix}^2 dx$$

$$=\tfrac{5}{2}d+3y-z+4dz-6yz-4d^2z+4z^2+4d^3-\tfrac{1}{4}-12z^2y-3d^2-12dy+12zy^2+12y^2d+\tfrac{8}{3}z^3-4y^3+a^2-\tfrac{a}{2}$$

First Order Condition:

$\frac{\partial}{\partial y}\Pi^{(3)}[y]=3-6z-12z^2-12d+24yz+24dy-12y^2=0$

Second Order Condition:

$\frac{\partial^2}{\partial y^2}\Pi^{(3)}[y]=24z+24d-24y\leq 0$, Solution is: $\{z+d\leq y\}$

Profit of the merged firm:

$$\Pi^{(3)}_{merged}\times 16=\int_0^{y-1/2}\begin{bmatrix} a+(z-x)+ \\ (1-y+x)-3(d-x)\end{bmatrix}^2 dx+\int_{y-1/2}^{z}\begin{bmatrix} a+(z-x)+ \\ (y-x)-3(d-x)\end{bmatrix}^2 dx$$

$$+\int_z^d[a+(x-z)+(y-x)-3(d-x)]^2\,dx+\int_d^{1/2}[a+(x-z)+(y-x)-3(x-d)]^2\,dx$$

$$+\int_{1/2}^{y}[a+(x-z)+(y-x)-3(1-d-x)]^2\,dx+\int_y^{1-d}[a+(x-z)+(x-y)-3(1-d-x)]^2\,dx$$

$$+\int_{1-d}^{z+1/2}\begin{bmatrix} a+(x-z)+(x-y) \\ -3(x-1+d)\end{bmatrix}^2 dx+\int_{z+1/2}^{1}\begin{bmatrix} a+(1-x+z)+(x-y) \\ -3(x-1+d)\end{bmatrix}^2 dx$$

$$=\tfrac{9}{2}d+3y+3z-12dz-4y^2+2yz+12d^2z-4z^2+4d^3+4z^2y-3d^2$$

$-12dy - 4zy^2 + 12y^2d + \frac{8}{3}z^3 + \frac{4}{3}y^3 - \frac{11}{12} - \frac{1}{2}a + a^2 + 6ad - 12ad^2$

First Order Condition:

$\frac{\partial}{\partial d}\Pi^{(3)}_{merged} = \frac{9}{2} - 12z + 24dz + 12d^2 - 6d - 12y + 12y^2 + 6a - 24ad = 0$

Second Order Condition:

$\frac{\partial^2}{\partial d^2}\Pi^{(3)}_{merged} = 24z + 24d - 6 - 24a \leq 0$, Solution is: $\left\{d \leq -z + \frac{1}{4} + a\right\}$

We solve the simultaneous system of FOCs with Mathematica:

```
z  Reals&&y  Reals&&d  Reals&&a  Reals;
z≥0&&y≥0&&d≥0&&a>2;
Reduce@
 8H9ê2L-12 z+24 d z+12 d^2-6 d-12 y+12 y^2+6 a-24 a d« 0,
  3-6 z-12 z^2-12 d+24 y z+24 d y-12 y^2« 0,
  3-12 d-6 y+12 d^2-24 y z+12 y^2+24 z^2« 0<, 8z, y, d<D


This system yields no rational solution.
  Case 11 has no valid solution.
```

Case 12: $0 \leq z \leq y - 1/2 \leq d \leq 1/2 \leq z + 1/2 \leq 1 - d \leq y \leq 1$

Profit of firm located at z:

$$\Pi^{(3)}[z] \times 16 = \int_0^z \left[\begin{array}{c} a + (1 - y + x) + \\ (d - x) - 3(z - x) \end{array}\right]^2 dx + \int_z^{y-1/2} \left[\begin{array}{c} a + (1 - y + x) + \\ (d - x) - 3(x - z) \end{array}\right]^2 dx$$
$$+ \int_{y-1/2}^{d} [a + (y - x) + (d - x) - 3(x - z)]^2 dx + \int_d^{1/2} [a + (y - x) + (x - d) - 3(x - z)]^2 dx$$
$$+ \int_{1/2}^{z+1/2} \left[\begin{array}{c} a + (y - x) + (1 - d - x) \\ -3(x - z) \end{array}\right]^2 dx + \int_{p+1/2}^{y} \left[\begin{array}{c} a + (y - x) + (1 - d - x) \\ -3(1 + z - x) \end{array}\right]^2 dx$$
$$+ \int_y^{1-d} \left[\begin{array}{c} a + (x - y) + (1 - d - x) \\ -3(1 + z - x) \end{array}\right]^2 dx + \int_{1-d}^{1} \left[\begin{array}{c} a + (x - y) + (x - 1 + d) \\ -3(1 + z - x) \end{array}\right]^2 dx$$
$$= 5y - \tfrac{1}{2}d - 6z - 12z^2d + 12z^2y - 4z^3 - 6z^2 + 18zy + 3d^2 + 4dy - 8y^2 - 12zy^2 - 4dy^2 + 4y^3 - \tfrac{3}{4} - \tfrac{16}{3}d^3 + a^2 - \tfrac{a}{2}$$

First Order Condition:

$\frac{\partial}{\partial z}\Pi^{(3)}[z] = -6 - 24zd + 24zy - 12z^2 - 12z + 18y - 12y^2 = 0$

Second Order Condition:

$\frac{\partial^2}{\partial z^2}\Pi^{(3)}[z] = 24y - 24d - 24z - 12 \leq 0$, Solution is: $\left\{y - d - \frac{1}{2} \leq z\right\}$

Remark: Given the initial conditions defining case 12, namely $z \leq y - 1/2 \leq d$, it is clear that this SOC can never be satisfied, therefore case 12 yields no solution.

Appendix B

Profitability analysis

- Pre-merger equilibrium

Profit values

$$\Pi_{1,2,3}(x_1^*) = \left[\begin{array}{c} \frac{1}{64}a + \frac{9}{128}x_1^* + \frac{3}{16}ax_1^* + \frac{1}{16}a^2 \\ -\frac{33}{64}(x_1^*)^2 + \frac{23}{32}(x_1^*)^3 - \frac{9}{16}a(x_1^*)^2 + \frac{7}{768} \end{array} \right]_{x_1^*=\frac{6}{23}a-\frac{1}{23}\sqrt{20a+36a^2+13}+\frac{11}{46}}$$

$$= \frac{25}{736}a + \frac{1}{16}a^2 - \frac{9}{2944}\sqrt{20a+36a^2+13} + \frac{3}{16}a\left(\frac{6}{23}a - \frac{1}{23}\sqrt{20a+36a^2+13} + \frac{11}{46}\right)$$
$$-\frac{33}{64}\left(\frac{6}{23}a - \frac{1}{23}\sqrt{20a+36a^2+13} + \frac{11}{46}\right)^2 + \frac{23}{32}\left(\frac{6}{23}a - \frac{1}{23}\sqrt{20a+36a^2+13} + \frac{11}{46}\right)^3$$
$$-\frac{9}{16}a\left(\frac{6}{23}a - \frac{1}{23}\sqrt{20a+36a^2+13} + \frac{11}{46}\right)^2 + \frac{229}{8832}$$

$$\Pi_4(x_1^*) = \left[\begin{array}{c} \frac{5}{128}x_1^* - \frac{3}{64}a - \frac{1}{16}ax_1^* + \frac{1}{16}a^2 \\ -\frac{13}{64}(x_1^*)^2 + \frac{17}{96}(x_1^*)^3 + \frac{3}{16}a(x_1^*)^2 + \frac{11}{768} \end{array} \right]_{x_1^*=\frac{6}{23}a-\frac{1}{23}\sqrt{20a+36a^2+13}+\frac{11}{46}}$$

$$= \frac{1}{16}a^2 - \frac{27}{736}a - \frac{5}{2944}\sqrt{20a+36a^2+13} - \frac{1}{16}a\left(\frac{6}{23}a - \frac{1}{23}\sqrt{20a+36a^2+13} + \frac{11}{46}\right)$$
$$-\frac{13}{64}\left(\frac{6}{23}a - \frac{1}{23}\sqrt{20a+36a^2+13} + \frac{11}{46}\right)^2 + \frac{17}{96}\left(\frac{6}{23}a - \frac{1}{23}\sqrt{20a+36a^2+13} + \frac{11}{46}\right)^3$$
$$+\frac{3}{16}a\left(\frac{6}{23}a - \frac{1}{23}\sqrt{20a+36a^2+13} + \frac{11}{46}\right)^2 + \frac{209}{8832}$$

$$\Pi_{1,2,3}(x_1^*)+\Pi_4(x_1^*) = \left[\begin{array}{c} \frac{10\,979}{97\,336}a^2 - \frac{7537}{194\,672}a + \frac{153}{12\,167}a^3 + \frac{745}{292\,008}\sqrt{20a+36a^2+13} \\ +\frac{191}{73\,002}a\sqrt{20a+36a^2+13} - \frac{51}{24\,334}a^2\sqrt{20a+36a^2+13} + \frac{22\,043}{1168\,032} \end{array} \right]$$

Evaluating this expression for the values of the demand parameter retained, we obtain those in Table 3.1. For instance,

$$[\Pi_{1,2,3}(x_1^*) + \Pi_4(x_1^*)]_{a=1.5}$$
$$= \left[\begin{array}{c} \frac{10\,979}{97\,336}a^2 - \frac{7537}{194\,672}a + \frac{153}{12\,167}a^3 + \frac{745}{292\,008}\sqrt{20a+36a^2+13}+ \\ \frac{191}{73\,002}a\sqrt{20a+36a^2+13} - \frac{51}{24\,334}a^2\sqrt{20a+36a^2+13} + \frac{22\,043}{1168\,032} \end{array} \right]_{a=1.5} = 0.276\,63$$

and $[\Pi_{1,2,3}(x_1^*) + \Pi_4(x_1^*)]_{a=2} = 0.484\,81$

- Post-merger equilibrium

$\Pi^M_{1,2,3,4} = \frac{4}{9}ax_2^M - \frac{1}{9}x_2^M - \frac{1}{18}a + \frac{2}{9}x_1^M x_2^M + \frac{4}{9}ax_1^M x_2^M + \frac{1}{9}a^2 - \frac{1}{3}\left(x_1^M\right)^2 + \frac{13}{27}\left(x_1^M\right)^3 + \frac{1}{9}\left(x_2^M\right)^2 + \frac{1}{27}\left(x_2^M\right)^3 - \frac{2}{3}a\left(x_1^M\right)^2 - \frac{2}{3}a\left(x_2^M\right)^2 - \frac{1}{3}\left(x_1^M\right)\left(x_2^M\right)^2 + \frac{1}{9}\left(x_2^M\right)\left(x_1^M\right)^2 + \frac{1}{36}$

This profit will be evaluated for the same values of the demand parameter as before - the corresponding values of $\left(x_1^M\right)^*$ and $\left(x_2^M\right)^*$ have been obtained by solving the simultaneous system of FOCs for the desired values of a :

The First Order Conditions' system was the following:

$$\begin{cases} \frac{\partial}{\partial x_1^M}\Pi^M_{1,2,3,4} = \frac{2}{9}x_2^M - \frac{2}{3}x_1^M - \frac{4}{3}ax_1^M + \frac{4}{9}ax_2^M + \frac{2}{9}x_1^M x_2^M + \frac{13}{9}\left(x_1^M\right)^2 - \frac{1}{3}\left(x_2^M\right)^2 = 0 \text{ and} \\ \frac{\partial}{\partial x_2^M}\Pi^M_{1,2,3,4} = \frac{4}{9}a + \frac{2}{9}x_1^M + \frac{2}{9}x_2^M + \frac{4}{9}ax_1^M - \frac{4}{3}ax_2^M - \frac{2}{3}x_1^M x_2^M + \frac{1}{9}\left(x_1^M\right)^2 + \frac{1}{9}\left(x_2^M\right)^2 - \frac{1}{9} = 0 \end{cases}$$

the Second Order Conditions (SOCs) are:

$$\begin{cases} \frac{\partial^2}{\partial\left(x_1^M\right)^2}\Pi^M_{1,2,3,4} = \frac{26}{9}\left(x_1^M\right) - \frac{4}{3}a + \frac{2}{9}\left(x_2^M\right) - \frac{2}{3} \leq 0 \text{ and} \\ \frac{\partial^2}{\partial\left(x_2^M\right)^2}\Pi^M_{1,2,3,4} = \frac{2}{9}\left(x_2^M\right) - \frac{2}{3}\left(x_1^M\right) - \frac{4}{3}a + \frac{2}{9} \leq 0 \end{cases}$$

Resolution method:

To find particular solutions to the FOCs system, the latter is evaluated for the target value of the demand parameter a, then the resulting two-unknown variable system is solved directly by using the Solve then Numeric commands in the Compute menu of the ScientificWorkplace main menu (version 4.0 or higher).

Start by denoting $\left(x_1^M\right)$ by p and $\left(x_2^M\right)$ by r, so as to largely simplify notations - this is important, to the extent that our initial notations x_1^M and x_2^M appear to interfere with the well functioning of the computing Maple application within ScientificWorkplace. Working with simpler notations ensures that Maple yields no programme error.

For $a = 1.5$, the FOC system will write:

$$\left[\begin{array}{c} \frac{2}{9}r - \frac{2}{3}p - \frac{4}{3}ap + \frac{4}{9}ar + \frac{2}{9}pr + \frac{13}{9}p^2 - \frac{1}{3}r^2 = 0 \\ \frac{4}{9}a + \frac{2}{9}p + \frac{2}{9}r + \frac{4}{9}ap - \frac{4}{3}ar - \frac{2}{3}pr + \frac{1}{9}p^2 + \frac{1}{9}r^2 - \frac{1}{9} = 0 \end{array}\right]_{a=3/2}$$

$$= \left[\begin{array}{c} -\frac{8}{3}p + \frac{8}{9}r + \frac{2}{9}pr + \frac{13}{9}p^2 - \frac{1}{3}r^2 = 0 \\ \frac{8}{9}p - \frac{16}{9}r - \frac{2}{3}pr + \frac{1}{9}p^2 + \frac{1}{9}r^2 + \frac{5}{9} = 0 \end{array}\right]$$

Applying the Solve Numeric command we obtain:

$$\text{Solution is: } \left\{ \begin{array}{c} [p=-4.297\,6, r=-10.796], [p=1.494\,5, r=0.793\,82], \\ [p=0.115\,37, r=0.363\,55], [p=-1.812\,3, r=6.138\,7] \end{array} \right\}$$

Since the two solutions correspond to locations on the segment, between 0 and 1/2, the only possible solution would be $[p=0.115\,37, r=0.363\,55]$, but we still check against the SOCs:

$\left[\frac{26}{9}p-\frac{4}{3}a+\frac{2}{9}r-\frac{2}{3}\right]_{p=0.115\,37,r=0.363\,55}=-\frac{4}{3}a-0.252\,59<0$

$\left[\frac{2}{9}r-\frac{2}{3}p-\frac{4}{3}a+\frac{2}{9}\right]_{p=0.115\,37,r=0.363\,55}=0.226\,10-\frac{4}{3}a<0$ for $a=1.5$

Conclusion: for $a=1.5 \Rightarrow \left(x_1^M\right)^*=0.115\,35, \left(x_2^M\right)^*=0.363\,54.$

$$\text{For } \underline{a=2}, \left[\begin{array}{c} \frac{2}{9}r-\frac{2}{3}p-\frac{4}{3}ap+\frac{4}{9}ar+\frac{2}{9}pr+\frac{13}{9}p^2-\frac{1}{3}r^2=0 \\ \frac{4}{9}a+\frac{2}{9}p+\frac{2}{9}r+\frac{4}{9}ap-\frac{4}{3}ar-\frac{2}{3}pr+\frac{1}{9}p^2+\frac{1}{9}r^2-\frac{1}{9}=0 \end{array} \right]_{a=2}$$

$$= \left[\begin{array}{c} -\frac{10}{3}p+\frac{10}{9}r+\frac{2}{9}pr+\frac{13}{9}p^2-\frac{1}{3}r^2=0 \\ \frac{10}{9}p-\frac{22}{9}r-\frac{2}{3}pr+\frac{1}{9}p^2+\frac{1}{9}r^2+\frac{7}{9}=0 \end{array} \right]$$

$$\text{Solution is: } \left\{ \begin{array}{c} [p=0.117\,64, r=0.366\,63], [p=-5.970\,1, r=-14.961], \\ [p=1.899\,3, r=0.911\,22], [p=-2.546\,9, r=8.182\,9] \end{array} \right\}$$

$\left[\frac{26}{9}p-\frac{4}{3}a+\frac{2}{9}r-\frac{2}{3}\right]_{p=0.117\,64,r=0.366\,63}=-\frac{4}{3}a-0.245\,34<0$

$\left[\frac{2}{9}r-\frac{2}{3}p-\frac{4}{3}a+\frac{2}{9}\right]_{p=0.117\,64,r=0.366\,63}=0.225\,27-\frac{4}{3}a<0$ for $a=2$

Conclusion: for$a=2 \Rightarrow \left(x_1^M\right)^*=0.0.11764, \left(x_2^M\right)^*=0.36663$

$$\text{for } \underline{a=2.5}, \left[\begin{array}{c} \frac{2}{9}r-\frac{2}{3}p-\frac{4}{3}ap+\frac{4}{9}ar+\frac{2}{9}pr+\frac{13}{9}p^2-\frac{1}{3}r^2=0 \\ \frac{4}{9}a+\frac{2}{9}p+\frac{2}{9}r+\frac{4}{9}ap-\frac{4}{3}ar-\frac{2}{3}pr+\frac{1}{9}p^2+\frac{1}{9}r^2-\frac{1}{9}=0 \end{array} \right]_{a=5/2}$$

$$= \left[\begin{array}{c} -4p+\frac{4}{3}r+\frac{2}{9}pr+\frac{13}{9}p^2-\frac{1}{3}r^2=0 \\ \frac{4}{3}p-\frac{28}{9}r-\frac{2}{3}pr+\frac{1}{9}p^2+\frac{1}{9}r^2+1=0 \end{array} \right]$$

$$\text{Solution is: } \left\{ \begin{array}{c} [p=2.304\,9, r=1.028\,7], [p=-3.281\,8, r=10.227], \\ [p=-7.642\,2, r=-19.124], [p=0.119\,05, r=0.368\,4] \end{array} \right\}$$

$\left[\frac{26}{9}p-\frac{4}{3}a+\frac{2}{9}r-\frac{2}{3}\right]_{p=0.119\,05,r=0.368\,4}=-\frac{4}{3}a-0.240\,88<0$

$\left[\frac{2}{9}r-\frac{2}{3}p-\frac{4}{3}a+\frac{2}{9}\right]_{p=0.119\,05,r=0.368\,4}=0.224\,72-\frac{4}{3}a<0$ for $a=2.5$

Conclusion: for$a=2.5 \Rightarrow \left(x_1^M\right)^*=0.119\,05, \left(x_2^M\right)^*=0.368\,4$

$$\text{for } \underline{a=3}, \left[\begin{array}{c} \frac{2}{9}r-\frac{2}{3}p-\frac{4}{3}ap+\frac{4}{9}ar+\frac{2}{9}pr+\frac{13}{9}p^2-\frac{1}{3}r^2=0 \\ \frac{4}{9}a+\frac{2}{9}p+\frac{2}{9}r+\frac{4}{9}ap-\frac{4}{3}ar-\frac{2}{3}pr+\frac{1}{9}p^2+\frac{1}{9}r^2-\frac{1}{9}=0 \end{array} \right]_{a=3}$$

$$= \left[\begin{array}{c} -\frac{14}{3}p + \frac{14}{9}r + \frac{2}{9}pr + \frac{13}{9}p^2 - \frac{1}{3}r^2 = 0 \\ \frac{14}{9}p - \frac{34}{9}r - \frac{2}{3}pr + \frac{1}{9}p^2 + \frac{1}{9}r^2 + \frac{11}{9} = 0 \end{array} \right]$$

$$\text{Solution is: } \left\{ \begin{array}{c} [p = 2.710\,9, r = 1.146\,2], [p = -4.016\,9, r = 12.27], \\ [p = -9.314, r = -23.286], [p = 0.120\,00, r = 0.369\,56] \end{array} \right\}$$

$$\left[\tfrac{26}{9}p - \tfrac{4}{3}a + \tfrac{2}{9}r - \tfrac{2}{3}\right]_{p=0.120\,00, r=0.369\,56} = -\tfrac{4}{3}a - 0.237\,88 < 0$$

$$\left[\tfrac{2}{9}r - \tfrac{2}{3}p - \tfrac{4}{3}a + \tfrac{2}{9}\right]_{p=0.120\,00, r=0.369\,56} = 0.224\,35 - \tfrac{4}{3}a < 0 \text{ for } a = 3$$

Conclusion: for $a = 3 \Rightarrow \left(x_1^M\right)^* = 0.120\,0, \left(x_2^M\right)^* = 0.369\,56$

$$\text{for } \underline{a = 3.5}, \left[\begin{array}{c} \frac{2}{9}r - \frac{2}{3}p - \frac{4}{3}ap + \frac{4}{9}ar + \frac{2}{9}pr + \frac{13}{9}p^2 - \frac{1}{3}r^2 = 0 \\ \frac{4}{9}a + \frac{2}{9}p + \frac{2}{9}r + \frac{4}{9}ap - \frac{4}{3}ar - \frac{2}{3}pr + \frac{1}{9}p^2 + \frac{1}{9}r^2 - \frac{1}{9} = 0 \end{array} \right]_{a=7/2}$$

$$= \left[\begin{array}{c} -\frac{16}{3}p + \frac{16}{9}r + \frac{2}{9}pr + \frac{13}{9}p^2 - \frac{1}{3}r^2 = 0 \\ \frac{16}{9}p - \frac{40}{9}r - \frac{2}{3}pr + \frac{1}{9}p^2 + \frac{1}{9}r^2 + \frac{13}{9} = 0 \end{array} \right]$$

$$\text{Solution is: } \left\{ \begin{array}{c} [p = 3.117\,1, r = 1.263\,8], [p = -4.752\,1, r = 14.314], \\ [p = -10.986, r = -27.448], [p = 0.120\,69, r = 0.370\,36] \end{array} \right\}$$

$$\left[\tfrac{26}{9}p - \tfrac{4}{3}a + \tfrac{2}{9}r - \tfrac{2}{3}\right]_{p=0.120\,69, r=0.370\,36} = -\tfrac{4}{3}a - 0.235\,7 < 0$$

$$\left[\tfrac{2}{9}r - \tfrac{2}{3}p - \tfrac{4}{3}a + \tfrac{2}{9}\right]_{p=0.120\,69, r=0.370\,36} = 0.224\,06 - \tfrac{4}{3}a < 0 \text{ for } a = 3.5$$

Conclusion: for $a = 3.5 \Rightarrow \left(x_1^M\right)^* = 0.120\,69, \left(x_2^M\right)^* = 0.370\,36$

$$\text{for } \underline{a = 4}, \left[\begin{array}{c} \frac{2}{9}r - \frac{2}{3}p - \frac{4}{3}ap + \frac{4}{9}ar + \frac{2}{9}pr + \frac{13}{9}p^2 - \frac{1}{3}r^2 = 0 \\ \frac{4}{9}a + \frac{2}{9}p + \frac{2}{9}r + \frac{4}{9}ap - \frac{4}{3}ar - \frac{2}{3}pr + \frac{1}{9}p^2 + \frac{1}{9}r^2 - \frac{1}{9} = 0 \end{array} \right]_{a=4}$$

$$= \left[\begin{array}{c} -6p + 2r + \frac{2}{9}pr + \frac{13}{9}p^2 - \frac{1}{3}r^2 = 0 \\ 2p - \frac{46}{9}r - \frac{2}{3}pr + \frac{1}{9}p^2 + \frac{1}{9}r^2 + \frac{5}{3} = 0 \end{array} \right]$$

$$\text{Solution is: } \left\{ \begin{array}{c} [p = -5.487\,3, r = 16.357], [p = 3.523\,5, r = 1.381\,4], \\ [p = 0.121\,21, r = 0.370\,96], [p = -12.657, r = -31.609] \end{array} \right\}$$

$$\left[\tfrac{26}{9}p - \tfrac{4}{3}a + \tfrac{2}{9}r - \tfrac{2}{3}\right]_{p=0.121\,21, r=0.370\,96} = -\tfrac{4}{3}a - 0.234\,07 < 0$$

$$\left[\tfrac{2}{9}r - \tfrac{2}{3}p - \tfrac{4}{3}a + \tfrac{2}{9}\right]_{p=0.121\,21, r=0.370\,96} = 0.223\,85 - \tfrac{4}{3}a < 0 \text{ for } a = 4$$

Conclusion: for $a = 4 \Rightarrow \left(x_1^M\right)^* = 0.121\,21, \left(x_2^M\right)^* = 0.370\,96$

$$\text{for } \underline{a = 4.5}, \left[\begin{array}{c} \frac{2}{9}r - \frac{2}{3}p - \frac{4}{3}ap + \frac{4}{9}ar + \frac{2}{9}pr + \frac{13}{9}p^2 - \frac{1}{3}r^2 = 0 \\ \frac{4}{9}a + \frac{2}{9}p + \frac{2}{9}r + \frac{4}{9}ap - \frac{4}{3}ar - \frac{2}{3}pr + \frac{1}{9}p^2 + \frac{1}{9}r^2 - \frac{1}{9} = 0 \end{array} \right]_{a=9/2}$$

$$= \left[\begin{array}{c} -\frac{20}{3}p + \frac{20}{9}r + \frac{2}{9}pr + \frac{13}{9}p^2 - \frac{1}{3}r^2 = 0 \\ \frac{20}{9}p - \frac{52}{9}r - \frac{2}{3}pr + \frac{1}{9}p^2 + \frac{1}{9}r^2 + \frac{17}{9} = 0 \end{array} \right]$$

Solution is: $\left\{ \begin{array}{c} [p=-6.\,222\,5, r=18.\,4], [p=-14.\,329, r=-35.\,771], \\ [p=0.121\,62, r=0.371\,43], [p=3.\,929\,9, r=1.\,498\,9] \end{array} \right\}$

$\left[\frac{26}{9}p-\frac{4}{3}a+\frac{2}{9}r-\frac{2}{3}\right]_{p=0.12162,r=0.37143} = -\frac{4}{3}a-0.232\,78 < 0$

$\left[\frac{2}{9}r-\frac{2}{3}p-\frac{4}{3}a+\frac{2}{9}\right]_{p=0.12162,r=0.37143} = 0.223\,68-\frac{4}{3}a < 0$ for $a=4.5$

Conclusion: for $a=4.5 \Rightarrow \left(x_1^M\right)^* = 0.121\,62, \left(x_2^M\right)^* = 0.37143$

for $\underline{a=5}$, $\left[\begin{array}{c} \frac{2}{9}r-\frac{2}{3}p-\frac{4}{3}ap+\frac{4}{9}ar+\frac{2}{9}pr+\frac{13}{9}p^2-\frac{1}{3}r^2=0 \\ \frac{4}{9}a+\frac{2}{9}p+\frac{2}{9}r+\frac{4}{9}ap-\frac{4}{3}ar-\frac{2}{3}pr+\frac{1}{9}p^2+\frac{1}{9}r^2-\frac{1}{9}=0 \end{array}\right]_{a=5}$

$= \left[\begin{array}{c} -\frac{22}{3}p+\frac{22}{9}r+\frac{2}{9}pr+\frac{13}{9}p^2-\frac{1}{3}r^2=0 \\ \frac{22}{9}p-\frac{58}{9}r-\frac{2}{3}pr+\frac{1}{9}p^2+\frac{1}{9}r^2+\frac{19}{9}=0 \end{array}\right]$

$\Rightarrow p=0.121951, r=0.371793$

$\left[\frac{26}{9}p-\frac{4}{3}a+\frac{2}{9}r-\frac{2}{3}\right]_{p=0.121951,r=0.371793} = -\frac{4}{3}a-0.231\,74 < 0$

$\left[\frac{2}{9}r-\frac{2}{3}p-\frac{4}{3}a+\frac{2}{9}\right]_{p=0.121951,r=0.371793} = 0.223\,54-\frac{4}{3}a < 0$ for $a=5$

Conclusion: for $a=5 \Rightarrow \left(x_1^M\right)^* = 0.121951, \left(x_2^M\right)^* = 0.371793$

for $\underline{a=6}$, $\left[\begin{array}{c} \frac{2}{9}r-\frac{2}{3}p-\frac{4}{3}ap+\frac{4}{9}ar+\frac{2}{9}pr+\frac{13}{9}p^2-\frac{1}{3}r^2=0 \\ \frac{4}{9}a+\frac{2}{9}p+\frac{2}{9}r+\frac{4}{9}ap-\frac{4}{3}ar-\frac{2}{3}pr+\frac{1}{9}p^2+\frac{1}{9}r^2-\frac{1}{9}=0 \end{array}\right]_{a=6}$

$= \left[\begin{array}{c} -\frac{26}{3}p+\frac{26}{9}r+\frac{2}{9}pr+\frac{13}{9}p^2-\frac{1}{3}r^2=0 \\ \frac{26}{9}p-\frac{70}{9}r-\frac{2}{3}pr+\frac{1}{9}p^2+\frac{1}{9}r^2+\frac{23}{9}=0 \end{array}\right]$

$\Rightarrow p=0.122449, r=0.372339$

$\left[\frac{26}{9}p-\frac{4}{3}a+\frac{2}{9}r-\frac{2}{3}\right]_{p=0.122449,r=0.372339} = -\frac{4}{3}a-0.230\,18$

$\left[\frac{2}{9}r-\frac{2}{3}p-\frac{4}{3}a+\frac{2}{9}\right]_{p=0.122449,r=0.372339} = 0.223\,33-\frac{4}{3}a$

Conclusion: for $a=6 \Rightarrow \left(x_1^M\right)^* = 0.122449, \left(x_2^M\right)^* = 0.372339$

By replacing these values in the profit expression for the group, $\Pi_{1,2,3,4}^M$, we obtain the values entered in Table 3.2

- Post-merger partial divisionalization equilibrium

Profit evaluation:

$\Pi_{1,2}+\Pi_{3,4} = 2\Pi_{1,2} = 2\times\left[\frac{1}{4}az-\frac{1}{16}z-\frac{1}{32}a+\frac{1}{16}a^2+\frac{1}{6}z^3-\frac{1}{2}az^2+\frac{1}{64}\right]_{z=a-\frac{1}{4}\sqrt{16a^2-8a+2}} =$

$= \frac{5}{8}a^2-\frac{3}{16}a-\frac{2}{3}a^3+\frac{1}{48}\sqrt{2}\sqrt{8a^2-4a+1}-\frac{1}{12}a\sqrt{2}\sqrt{8a^2-4a+1}+\frac{1}{6}a^2\sqrt{2}\sqrt{8a^2-4a+1}+$

$\frac{1}{32}$

Evaluating this expression for the values of the demand parameter retained, we obtain the values reported in Table 3.4. For instance,

$\left[\frac{5}{8}a^2 - \frac{3}{16}a - \frac{2}{3}a^3 + \frac{1}{48}\sqrt{2}\sqrt{8a^2-4a+1} - \frac{1}{12}a\sqrt{2}\sqrt{8a^2-4a+1} + \frac{1}{6}a^2\sqrt{2}\sqrt{8a^2-4a+1} + \frac{1}{32}\right]_{a=1.5} = 0.287\,18$

and

$\left[\frac{5}{8}a^2 - \frac{3}{16}a - \frac{2}{3}a^3 + \frac{1}{48}\sqrt{2}\sqrt{8a^2-4a+1} - \frac{1}{12}a\sqrt{2}\sqrt{8a^2-4a+1} + \frac{1}{6}a^2\sqrt{2}\sqrt{8a^2-4a+1} + \frac{1}{32}\right]_{a=2} = 0.505\,76$

Price analysis

The general price expression is: $P(x) = a - Q^*(x)$, where $Q^*(x)$ is total output at market point x.

- Compare prices before and after merger

Price before merger (1,2,3 - 4 - 5)

- for $x \in [0; x_1^*]$, $P_{bef} = a - \frac{a-3\left(x_1^*-x\right)+2(1/2-x)}{4} - 2\frac{a-3(1/2-x)+(1/2-x)+\left(x_1^*-x\right)}{4} = \frac{1}{4}a - \frac{3}{4}x + \frac{1}{4}x_1^* + \frac{1}{4}$

- for $x \in [x_1^*; 1/2]$, $P_{bef} = a - \frac{a-3\left(x-x_1^*\right)+2(1/2-x)}{4} - 2\frac{a-3(1/2-x)+(1/2-x)+\left(x-x_1^*\right)}{4} = \frac{1}{4}a - \frac{1}{4}x - \frac{1}{4}x_1^* + \frac{1}{4}$

Price after merger (1,2,3,4 - 5)

- for $x \in \left[0, \left(x_1^M\right)^*\right]$, $P_{merger}(x) = a - \frac{a-2\left(\left(x_1^M\right)^*-x\right)+\left(\frac{1}{2}-x\right)}{3} - \frac{a-2\left(\frac{1}{2}-x\right)+\left(\left(x_1^M\right)^*-x\right)}{3} = \frac{1}{3}a + \frac{1}{3}\left(x_1^M\right)^* - \frac{2}{3}x + \frac{1}{6}$

- for $x \in \left[\left(x_1^M\right)^*, \frac{\left(x_1^M\right)^*+\left(x_2^M\right)^*}{2}\right]$, $P_{merger}(x) = a - \frac{a-2\left(x-\left(x_1^M\right)^*\right)+\left(\frac{1}{2}-x\right)}{3} - \frac{a-2\left(\frac{1}{2}-x\right)+\left(x-\left(x_1^M\right)^*\right)}{3} = \frac{1}{3}a - \frac{1}{3}\left(x_1^M\right)^* + \frac{1}{6}$

- for $x \in \left[\frac{\left(x_1^M\right)^*+\left(x_2^M\right)^*}{2}, \left(x_2^M\right)^*\right]$, $P_{merger}(x) = a - \frac{a-2\left(\left(x_2^M\right)^*-x\right)+\left(\frac{1}{2}-x\right)}{3} - \frac{a-2\left(\frac{1}{2}-x\right)+\left(\left(x_2^M\right)^*-x\right)}{3} = \frac{1}{3}a + \frac{1}{3}\left(x_2^M\right)^* - \frac{2}{3}x + \frac{1}{6}$

- for $x \in \left[\left(x_2^M\right)^*, \frac{1}{2}\right]$, $P_{merger}(x) = a - \frac{a-2\left(x-\left(x_2^M\right)^*\right)+\left(\frac{1}{2}-x\right)}{3} - \frac{a-2\left(\frac{1}{2}-x\right)+\left(x-\left(x_2^M\right)^*\right)}{3} = \frac{1}{3}a - \frac{1}{3}\left(x_2^M\right)^* + \frac{1}{6}$

With multi-plant spatial Cournot competition, a plant's market area extends up to the mid-distance from the next plant belonging to the same firm (see Pal and Sarkar (2002)).

Therefore, one needs first compare $\frac{\left(x_1^M\right)^*+\left(x_2^M\right)^*}{2}$ and x_1^* so as to determine intervals for the post-merger comparison.

a	$\left(x_1^M\right)^*$	$\left(x_2^M\right)^*$	$\frac{\left(x_1^M\right)^*+\left(x_2^M\right)^*}{2}$		x_1^*
1.5	0.11535	0.36354	0.239 45	$>$	0.146 28
2	0.11764	0.36663	0.242135	$>$	0.150 62
2.5	0.11905	0.36840	0.243 725	$>$	0.153 45
3	0.12	0.36956	0.244 78	$>$	0.155 44
3.5	0.12069	0.37036	0.245 53	$>$	0.156 91
4	0.12121	0.37096	0.246 085	$>$	0.158 04
4.5	0.12162	0.37143	0.246 525	$>$	0.158 94
5	0.121951	0.371793	0.246 87	$>$	0.159 67
6	0.122449	0.372339	0.247 39	$>$	0.160 78

Since the price comparison will be performed on the following intervals:

∘) for $x \in \left[0; \left(x_1^M\right)^*\right]$, $\Delta P = P_{merger} - P_{before} = \left(\frac{1}{3}a + \frac{1}{3}\left(x_1^M\right)^* - \frac{2}{3}x + \frac{1}{6}\right) - \left(\frac{1}{4}a - \frac{3}{4}x + \frac{1}{4}x_1^* + \frac{1}{4}\right) = \frac{1}{12}a + \frac{1}{12}x + \frac{1}{3}\left(x_1^M\right)^* - \frac{1}{4}x_1^* - \frac{1}{12} > 0$ given the values of a, x, x_1^* and $\left(x_1^M\right)^*$, because

$$\Delta P_{x\in\left[0;\left(x_1^M\right)^*\right]} = \underbrace{\left(\frac{1}{12}a - \frac{1}{12}\right)}_{>0} + \underbrace{\frac{1}{12}x}_{\geq 0} + \underbrace{\left[\frac{1}{3}\left(x_1^M\right)^* - \frac{1}{4}x_1^*\right]_{x_1^*=0.146\,28,\left(x_1^M\right)^*=0.11535}}_{0.001\,88} > 0$$

∘) for $x \in \left[\left(x_1^M\right)^*; x_1^*\right]$, $\Delta P = P_{merger} - P_{before} = \left(\frac{1}{3}a - \frac{1}{3}\left(x_1^M\right)^* + \frac{1}{6}\right) - \left(\frac{1}{4}a - \frac{3}{4}x + \frac{1}{4}x_1^* + \frac{1}{4}\right) = \frac{1}{12}a + \frac{3}{4}x - \frac{1}{3}\left(x_1^M\right)^* - \frac{1}{4}x_1^* - \frac{1}{12} > 0$, by the same token

∘) for $x \in \left[\left(x_1^M\right)^*; \frac{\left(x_1^M\right)^*+\left(x_2^M\right)^*}{2}\right]$, $\Delta P = P_{merger} - P_{before} = \left(\frac{1}{3}a - \frac{1}{3}\left(x_1^M\right)^* + \frac{1}{6}\right) - \left(\frac{1}{4}a - \frac{1}{4}x - \frac{1}{4}x_1^* + \frac{1}{4}\right) = \frac{1}{12}a + \frac{1}{4}x - \frac{1}{3}\left(x_1^M\right)^* + \frac{1}{4}x_1^* - \frac{1}{12} > 0$, by the same token

∘) for $x \in \left[\frac{\left(x_1^M\right)^*+\left(x_2^M\right)^*}{2}; \left(x_2^M\right)^*\right]$, $\Delta P = P_{merger} - P_{before} = \left(\frac{1}{3}a + \frac{1}{3}\left(x_2^M\right)^* - \frac{2}{3}x + \frac{1}{6}\right) - \left(\frac{1}{4}a - \frac{1}{4}x - \frac{1}{4}x_1^* + \frac{1}{4}\right) = \frac{1}{12}a - \frac{5}{12}x + \frac{1}{3}\left(x_2^M\right)^* + \frac{1}{4}x_1^* - \frac{1}{12} > 0$, by the same method

∘) for $x \in \left[\left(x_2^M\right)^*; 1/2\right]$, $\Delta P = P_{merger} - P_{before} = \left(\frac{1}{3}a - \frac{1}{3}\left(x_2^M\right)^* + \frac{1}{6}\right) - \left(\frac{1}{4}a - \frac{1}{4}x - \frac{1}{4}x_1^* + \frac{1}{4}\right) = \frac{1}{12}a + \frac{1}{4}x - \frac{1}{3}\left(x_2^M\right)^* + \frac{1}{4}x_1^* - \frac{1}{12} > 0$, by the same method

- Price comparison: divestiture - merger

Price after spin-off/divestiture (1,2 - 3,4 - 5)

- for $x \in [0, z^*]$, $P_{div}(x) = a - \frac{a-3(\frac{1}{2}-x)+2(z^*-x)}{4} - 2\frac{a-2(z^*-x)+(\frac{1}{2}-x)}{4} = \frac{1}{4}a + \frac{1}{2}z^* - \frac{3}{4}x + \frac{1}{8}$
- for $x \in \left[z^*, \frac{1}{2}\right]$, $P_{div}(x) = a - \frac{a-3(\frac{1}{2}-x)+2(x-z^*)}{4} - 2\frac{a-2(x-z^*)+(\frac{1}{2}-x)}{4} = \frac{1}{4}a + \frac{1}{4}x - \frac{1}{2}z^* + \frac{1}{8}$

Compare $\frac{\left(x_1^M\right)^*+\left(x_2^M\right)^*}{2}$ with z^*:

a	$\left(x_1^M\right)^*$	$\left(x_2^M\right)^*$	$\frac{\left(x_1^M\right)^*+\left(x_2^M\right)^*}{2}$		z^*
1.5	0.11535	0.36354	0.239 45	$>$	0.225 24
2	0.11764	0.36663	0.242135	$>$	0.232 23
2.5	0.11905	0.36840	0.243 725	$>$	0.236 15
3	0.12	0.36956	0.244 78	$>$	0.238 66
3.5	0.12069	0.37036	0.245 53	$>$	0.240 40
4	0.12121	0.37096	0.246 085	$>$	0.241 68
4.5	0.12162	0.37143	0.246 525	$>$	0.242 65
5	0.121951	0.371793	0.246 87	$>$	0.243 43
6	0.122449	0.372339	0.247 39	$>$	0.244 57

Thus the price comparison will be performed as follows:

∘) for $x \in \left[0; \left(x_1^M\right)^*\right]$, $\Delta P = P_{div} - P_{merger} = \left(\frac{1}{4}a + \frac{1}{2}z^* - \frac{3}{4}x + \frac{1}{8}\right) - \left(\frac{1}{3}a + \frac{1}{3}\left(x_1^M\right)^* - \frac{2}{3}x + \frac{1}{6}\right) = \frac{1}{2}z^* - \frac{1}{12}x - \frac{1}{12}a - \frac{1}{3}\left(x_1^M\right)^* - \frac{1}{24} < 0$, because the expression is decreasing with x, and $\left[\frac{1}{2}z^* - \frac{1}{12}x - \frac{1}{12}a - \frac{1}{3}\left(x_1^M\right)^* - \frac{1}{24}\right]_{\left(x_1^M\right)^*=0.11535, z^*=0.225\,24, x=0} = 3.250\,3 \times 10^{-2} - \frac{1}{12}a < 0$ for any $a \geq 1.5$

∘) for $x \in \left[\left(x_1^M\right)^*; z^*\right]$, $\Delta P = P_{div} - P_{merger} = \left(\frac{1}{4}a + \frac{1}{2}z^* - \frac{3}{4}x + \frac{1}{8}\right) - \left(\frac{1}{3}a - \frac{1}{3}\left(x_1^M\right)^* + \frac{1}{6}\right) = \frac{1}{2}z^* - \frac{3}{4}x - \frac{1}{12}a + \frac{1}{3}\left(x_1^M\right)^* - \frac{1}{24} < 0$ by the same method

∘) for $\left[z^*; \frac{\left(x_1^M\right)^*+\left(x_2^M\right)^*}{2}\right]$, $\Delta P = P_{div} - P_{merger} = \left(\frac{1}{4}a + \frac{1}{4}x - \frac{1}{2}z^* + \frac{1}{8}\right) - \left(\frac{1}{3}a - \frac{1}{3}\left(x_1^M\right)^* + \frac{1}{6}\right) = \frac{1}{4}x - \frac{1}{12}a - \frac{1}{2}z^* + \frac{1}{3}\left(x_1^M\right)^* - \frac{1}{24} < 0$, by the same token

∘) for $x \in \left[\frac{\left(x_1^M\right)^*+\left(x_2^M\right)^*}{2}; \left(x_2^M\right)^*\right]$, $\Delta P = P_{div} - P_{merger} = \left(\frac{1}{4}a + \frac{1}{4}x - \frac{1}{2}z^* + \frac{1}{8}\right) - \left(\frac{1}{3}a + \frac{1}{3}\left(x_2^M\right)^* - \frac{2}{3}x + \frac{1}{6}\right) = \frac{11}{12}x - \frac{1}{12}a - \frac{1}{2}z^* - \frac{1}{3}\left(x_2^M\right)^* - \frac{1}{24} < 0$ by the same token

∘) for $x \in \left[\left(x_2^M\right)^*; 1/2\right]$, $\Delta P = P_{div} - P_{merger} = \left(\frac{1}{4}a + \frac{1}{4}x - \frac{1}{2}z^* + \frac{1}{8}\right) - \left(\frac{1}{3}a - \frac{1}{3}\left(x_2^M\right)^* + \frac{1}{6}\right) = \frac{1}{4}x - \frac{1}{12}a - \frac{1}{2}z^* + \frac{1}{3}\left(x_2^M\right)^* - \frac{1}{24} < 0$ by the same method

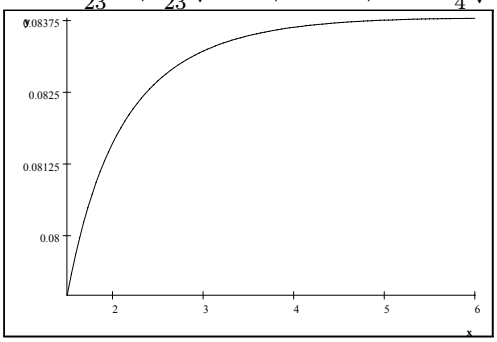
- Price comparison between divestiture and initial situation/before merger

Price before merger (1,2,3 - 4 - 5):

Compare $z^* = a - \frac{1}{4}\sqrt{16a^2 - 8a + 2}$ with $x_1^* = \frac{6}{23}a - \frac{1}{23}\sqrt{20a + 36a^2 + 13} + \frac{11}{46}$

$\left(a - \frac{1}{4}\sqrt{16a^2 - 8a + 2}\right) - \left(\frac{6}{23}a - \frac{1}{23}\sqrt{20a + 36a^2 + 13} + \frac{11}{46}\right) =$

$= \frac{17}{23}a + \frac{1}{23}\sqrt{20a+36a^2+13} - \frac{1}{4}\sqrt{2}\sqrt{8a^2-4a+1} - \frac{11}{46} > 0$ for all[26] $a \in [1.5;6]$



Price comparison:

$\circ$) for $x \in [0; x_1^*]$, $\Delta P = P_{div} - P_{before} = \left(\frac{1}{4}a + \frac{1}{2}z^* - \frac{3}{4}x + \frac{1}{8}\right) - \left(\frac{1}{4}a - \frac{3}{4}x + \frac{1}{4}x_1^* + \frac{1}{4}\right) = \frac{1}{2}z^* - \frac{1}{4}x_1^* - \frac{1}{8}$

$\left[\frac{1}{2}z^* - \frac{1}{4}x_1^* - \frac{1}{8}\right]_{z^*=a-\frac{1}{4}\sqrt{16a^2-8a+2}, x_1^*=\frac{6}{23}a-\frac{1}{23}\sqrt{20a+36a^2+13}+\frac{11}{46}} = \frac{10}{23}a + \frac{1}{92}\sqrt{20a+36a^2+13} - \frac{1}{8}\sqrt{2}\sqrt{8a^2-4a+1} - \frac{17}{92} < 0, \forall a \in [1.5, 6]$

Compute "gain" for consumers:

$\int_0^{\frac{6}{23}a-\frac{1}{23}\sqrt{20a+36a^2+13}+\frac{11}{46}} \left(\frac{10}{23}a + \frac{1}{92}\sqrt{20a+36a^2+13} - \frac{1}{8}\sqrt{2}\sqrt{8a^2-4a+1} - \frac{17}{92}\right) dx$

$= \frac{49}{1058}a + \frac{51}{529}a^2 + \frac{45}{4232}\sqrt{20a+36a^2+13} - \frac{17}{1058}a\sqrt{20a+36a^2+13} - \frac{11}{368}\sqrt{2}\sqrt{8a^2-4a+1}$

$-\frac{3}{92}a\sqrt{2}\sqrt{8a^2-4a+1} + \frac{1}{184}\sqrt{2}\sqrt{8a^2-4a+1}\sqrt{20a+36a^2+13} - \frac{213}{4232}$

$\circ$) for $x \in [x_1^*; z^*]$, $\Delta P = P_{div} - P_{before} = \left(\frac{1}{4}a + \frac{1}{2}z^* - \frac{3}{4}x + \frac{1}{8}\right) - \left(\frac{1}{4}a - \frac{1}{4}x - \frac{1}{4}x_1^* + \frac{1}{4}\right) = \frac{1}{2}z^* - \frac{1}{2}x + \frac{1}{4}x_1^* - \frac{1}{8}$

$\left[\frac{1}{2}z^* - \frac{1}{2}x + \frac{1}{4}x_1^* - \frac{1}{8}\right]_{z^*=a-\frac{1}{4}\sqrt{16a^2-8a+2}, x_1^*=\frac{6}{23}a-\frac{1}{23}\sqrt{20a+36a^2+13}+\frac{11}{46}} =$

$= \frac{13}{23}a - \frac{1}{2}x - \frac{1}{92}\sqrt{20a+36a^2+13} - \frac{1}{8}\sqrt{2}\sqrt{8a^2-4a+1} - \frac{3}{46} < 0, \forall a \in [1.5, 6]$

Compute "gain" for consumers:

$\int_{\frac{6}{23}a-\frac{1}{23}\sqrt{20a+36a^2+13}+\frac{11}{46}}^{a-\frac{1}{4}\sqrt{16a^2-8a+2}} \left(\frac{13}{23}a - \frac{1}{2}x - \frac{1}{92}\sqrt{20a+36a^2+13} - \frac{1}{8}\sqrt{2}\sqrt{8a^2-4a+1} - \frac{3}{46}\right) dx$

$= \frac{10}{23}a^2 - \frac{51}{184}a - \frac{1}{184}\sqrt{20a+36a^2+13} + \frac{1}{92}a\sqrt{20a+36a^2+13} + \frac{17}{368}\sqrt{2}\sqrt{8a^2-4a+1} -$

$\frac{5}{46}a\sqrt{2}\sqrt{8a^2-4a+1} - \frac{1}{368}\sqrt{2}\sqrt{8a^2-4a+1}\sqrt{20a+36a^2+13} + \frac{45}{736}$

$\circ$) for $x \in [z^*; 1/2]$, $\Delta P = P_{div} - P_{before} = \left(\frac{1}{4}a + \frac{1}{4}x - \frac{1}{2}z^* + \frac{1}{8}\right) - \left(\frac{1}{4}a - \frac{1}{4}x - \frac{1}{4}x_1^* + \frac{1}{4}\right) = \frac{1}{2}x - \frac{1}{2}z^* + \frac{1}{4}x_1^* - \frac{1}{8}$

[26] The subsequent price comparisons hold for the same interval - we basically obtain them by plotting the expressions, since the latter are 'simple', i.e. funtion of one variable only, the demand parameter.

$\left[\frac{1}{2}x-\frac{1}{2}z^*+\frac{1}{4}x_1^*-\frac{1}{8}\right]_{z^*=a-\frac{1}{4}\sqrt{16a^2-8a+2},x_1^*=\frac{6}{23}a-\frac{1}{23}\sqrt{20a+36a^2+13}+\frac{11}{46},x=a-\frac{1}{4}\sqrt{16a^2-8a+2}}=\frac{3}{46}a-\frac{1}{92}\sqrt{20a+36a^2+13}-\frac{3}{46}<0,\forall a\in[1.5,6]$

but $\left[\frac{1}{2}x-\frac{1}{2}z^*+\frac{1}{4}x_1^*-\frac{1}{8}\right]_{z^*=a-\frac{1}{4}\sqrt{16a^2-8a+2},x_1^*=\frac{6}{23}a-\frac{1}{23}\sqrt{20a+36a^2+13}+\frac{11}{46},x=1/2}=\frac{1}{8}\sqrt{2}\sqrt{8a^2-4a+1}-\frac{1}{92}\sqrt{20a+36a^2+13}-\frac{10}{23}a+\frac{17}{92}>0,\forall a\in[1.5,6]$

In order to determine the effect on consumer, one needs first to find the location $\widehat{x}$ starting from which price goes up:

$\left[\frac{1}{2}x-\frac{1}{2}z^*+\frac{1}{4}x_1^*-\frac{1}{8}\right]_{z^*=a-\frac{1}{4}\sqrt{16a^2-8a+2},x_1^*=\frac{6}{23}a-\frac{1}{23}\sqrt{20a+36a^2+13}+\frac{11}{46}}=\frac{1}{2}x-\frac{10}{23}a-\frac{1}{92}\sqrt{20a+36a^2+13}+\frac{1}{8}\sqrt{2}\sqrt{8a^2-4a+1}-\frac{3}{46}$

$\frac{1}{2}x-\frac{10}{23}a-\frac{1}{92}\sqrt{20a+36a^2+13}+\frac{1}{8}\sqrt{2}\sqrt{8a^2-4a+1}-\frac{3}{46}=0$, Solution is: $\frac{20}{23}a+\frac{1}{46}\sqrt{20a+36a^2+13}-\frac{1}{4}\sqrt{2}\sqrt{8a^2-4a+1}+\frac{3}{23}=\widehat{x}$

evaluate ΔP

$\Delta P=\left[\frac{1}{2}x-\frac{1}{2}z^*+\frac{1}{4}x_1^*-\frac{1}{8}\right]_{z^*=a-\frac{1}{4}\sqrt{16a^2-8a+2},x_1^*=\frac{6}{23}a-\frac{1}{23}\sqrt{20a+36a^2+13}+\frac{11}{46}}=\frac{1}{2}x-\frac{10}{23}a-\frac{1}{92}\sqrt{20a+36a^2+13}+\frac{1}{8}\sqrt{2}\sqrt{8a^2-4a+1}-\frac{3}{46}$

Compute "gain" over $[z^*;\widehat{x}]$

$$\int_{a-\frac{1}{4}\sqrt{16a^2-8a+2}}^{\frac{20}{23}a+\frac{1}{46}\sqrt{20a+36a^2+13}-\frac{1}{4}\sqrt{2}\sqrt{8a^2-4a+1}+\frac{3}{23}}\begin{pmatrix}\frac{1}{2}x-\frac{10}{23}a-\frac{1}{92}\sqrt{20a+36a^2+13}\\+\frac{1}{8}\sqrt{2}\sqrt{8a^2-4a+1}-\frac{3}{46}\end{pmatrix}dx$$
$$=\frac{10}{23}a^2-\frac{51}{184}a-\frac{1}{184}\sqrt{20a+36a^2+13}+\frac{1}{92}a\sqrt{20a+36a^2+13}+\frac{17}{368}\sqrt{2}\sqrt{8a^2-4a+1}-\frac{5}{46}a\sqrt{2}\sqrt{8a^2-4a+1}-\frac{1}{368}\sqrt{2}\sqrt{8a^2-4a+1}\sqrt{20a+36a^2+13}+\frac{45}{736}$$

Compute "loss" over $[\widehat{x};1/2]$

$$\int_{\frac{20}{23}a+\frac{1}{46}\sqrt{20a+36a^2+13}-\frac{1}{4}\sqrt{2}\sqrt{8a^2-4a+1}+\frac{3}{23}}^{1/2}\begin{pmatrix}\frac{1}{2}x-\frac{10}{23}a-\frac{1}{92}\sqrt{20a+36a^2+13}\\+\frac{1}{8}\sqrt{2}\sqrt{8a^2-4a+1}-\frac{3}{46}\end{pmatrix}dx$$
$$=\frac{469}{1058}a^2-\frac{1199}{4232}a-\frac{17}{4232}\sqrt{20a+36a^2+13}+\frac{5}{529}a\sqrt{20a+36a^2+13}+\frac{17}{368}\sqrt{2}\sqrt{8a^2-4a+1}-\frac{5}{46}a\sqrt{2}\sqrt{8a^2-4a+1}-\frac{1}{368}\sqrt{2}\sqrt{8a^2-4a+1}\sqrt{20a+36a^2+13}+\frac{1133}{16\,928}$$

Total effect on consumers throughout the market $[0;1/2]$:

$$\begin{pmatrix}\frac{49}{1058}a+\frac{51}{529}a^2+\frac{45}{4232}\sqrt{20a+36a^2+13}-\frac{17}{1058}a\sqrt{20a+36a^2+13}\\-\frac{11}{368}\sqrt{2}\sqrt{8a^2-4a+1}-\frac{3}{92}a\sqrt{2}\sqrt{8a^2-4a+1}+\frac{1}{184}\sqrt{2}\sqrt{8a^2-4a+1}\sqrt{20a+36a^2+13}-\frac{213}{4232}\end{pmatrix}$$
$$+\begin{pmatrix}\frac{10}{23}a^2-\frac{51}{184}a-\frac{1}{184}\sqrt{20a+36a^2+13}+\frac{1}{92}a\sqrt{20a+36a^2+13}\\+\frac{17}{368}\sqrt{2}\sqrt{8a^2-4a+1}-\frac{5}{46}a\sqrt{2}\sqrt{8a^2-4a+1}-\frac{1}{368}\sqrt{2}\sqrt{8a^2-4a+1}\sqrt{20a+36a^2+13}+\frac{45}{736}\end{pmatrix}$$
$$+\begin{pmatrix}\frac{469}{1058}a^2-\frac{1199}{4232}a-\frac{17}{4232}\sqrt{20a+36a^2+13}+\frac{5}{529}a\sqrt{20a+36a^2+13}\\+\frac{17}{368}\sqrt{2}\sqrt{8a^2-4a+1}-\frac{5}{46}a\sqrt{2}\sqrt{8a^2-4a+1}-\frac{1}{368}\sqrt{2}\sqrt{8a^2-4a+1}\sqrt{20a+36a^2+13}+\frac{1133}{16\,928}\end{pmatrix}$$

$= \frac{1031}{1058}a^2 - \frac{272}{529}a + \frac{5}{4232}\sqrt{20a+36a^2+13} + \frac{9}{2116}a\sqrt{20a+36a^2+13} + \frac{1}{16}\sqrt{2}\sqrt{8a^2-4a+1} - \frac{1}{4}a\sqrt{2}\sqrt{8a^2-4a+1} + \frac{329}{4232} < 0, \forall a \in [1.5, 6]$

meaning that the total gain of consumers over $[0; \widehat{x}]$ > total loss of consumers over $[\widehat{x}; 1/2]$

Conclusion: Overall positive effect of divestiture

Supplementary material: Profitability analysis when the outsider is a two-plant firm

Pre-merger equilibrium

Let one of the firms operate two outlets instead of only one as before. The total number of stores active on the market is now 6, within the following pattern: the two merger partners operate three and one store respectively, whereas the future-to-be outsider operates two.

Following the analysis of Pal and Sarkar (2002) on spatial multi-plant Cournot competition on the segment market, we know that the two-store firm will locate its outlets symmetrically on each side of the segment mid-point. In turn, the three-plant firm will locate one of them exactly at the segment centre, sharing it together with the single-plant firm, whereas the two remaining outlets take symmetric locations on each side. Denote m the location of the left-hand side store of the three-store plant, and q that of the left-hand side plant of the two-plant firm. These locations need to be determined so as to compute the pre-merger profits.

Following the same notations as in the body of the chapter 3, and given the 6 stores active now on the market, let $\Pi_{1,2,3}$ the profit for the three-plant firm, $\Pi_{4,5}$ that of the two-plant firm, and finally Π_6 the profit of the single-store firm.

Profits[27] write:

$$\Pi_6 = 2\left(\begin{array}{c} \int_0^m \left(\frac{a-3(1/2-x)+(q-x)+(m-x)}{4}\right)^2 dx + \int_m^q \left(\frac{a-3(1/2-x)+(q-x)+(x-m)}{4}\right)^2 dx + \\ \int_q^{\frac{m+1/2}{2}} \left(\frac{a-3(1/2-x)+(x-q)+(x-m)}{4}\right)^2 dx + \int_{\frac{m+1/2}{2}}^{1/2} \left(\frac{a-3(1/2-x)+(x-q)+(1/2-x)}{4}\right)^2 dx \end{array}\right) =$$

[27] The profits' expression implicitly take into account the fact that in the pre-merger location equilibrium, not only $0 < m < q < 1/2$, but also $q < \frac{m+1/2}{2}$. This condition will be checked below for every couple of solutions found.

$\frac{7}{128}m-\frac{3}{64}a+\frac{3}{64}q-\frac{1}{16}am-\frac{1}{8}aq+\frac{1}{16}mq+\frac{1}{16}a^2-\frac{21}{64}m^2+\frac{5}{32}m^3-\frac{5}{16}q^2+\frac{1}{3}q^3+\frac{3}{16}am^2+\frac{1}{4}aq^2-\frac{1}{4}$
$mq^2+\frac{5}{16}m^2q+\frac{23}{768}$

$$\Pi_{1,2,3}=2\left(\begin{array}{c}\int_0^m\left(\frac{a-3(m-x)+(q-x)+(1/2-x)}{4}\right)^2dx+\int_m^q\left(\frac{a-3(x-m)+(q-x)+(1/2-x)}{4}\right)^2dx+\\ \int_q^{\frac{m+1/2}{2}}\left(\frac{a-3(x-m)+(x-q)+(1/2-x)}{4}\right)^2dx+\int_{\frac{m+1/2}{2}}^{1/2}\left(\frac{a-3(1/2-x)+(x-q)+(1/2-x)}{4}\right)^2dx\end{array}\right)=$$

$\frac{1}{64}a+\frac{3}{128}m-\frac{1}{64}q+\frac{3}{16}am-\frac{1}{8}aq-\frac{3}{16}mq+\frac{1}{16}a^2-\frac{9}{64}m^2+\frac{25}{32}m^3+\frac{3}{16}q^2-\frac{1}{3}q^3-\frac{9}{16}am^2+\frac{1}{4}aq^2+\frac{3}{4}$
$mq^2-\frac{15}{16}m^2q+\frac{1}{256}$

$$\Pi_{4,5}=2\left(\begin{array}{c}\int_0^m\left(\frac{a-3(q-x)+(m-x)+(1/2-x)}{4}\right)^2dx+\int_m^q\left(\frac{a-3(q-x)+(x-m)+(1/2-x)}{4}\right)^2dx+\\ \int_q^{\frac{m+1/2}{2}}\left(\frac{a-3(x-q)+(x-m)+(1/2-x)}{4}\right)^2dx+\int_{\frac{m+1/2}{2}}^{1/2}\left(\frac{a-3(x-q)+(1/2-q)+(1/2-x)}{4}\right)^2dx\end{array}\right)=$$

$\frac{5}{16}aq-\frac{1}{256}m-\frac{5}{128}q-\frac{3}{32}am-\frac{3}{128}a-\frac{9}{32}mq+\frac{1}{8}amq+\frac{1}{16}a^2+\frac{27}{128}m^2+\frac{55}{192}m^3+\frac{1}{32}q^2+\frac{5}{32}am^2-$
$\frac{3}{4}aq^2+\frac{17}{16}mq^2-\frac{37}{32}m^2q+\frac{19}{1536}$

To determine the pre-merger locations m and q, we need to solve for the pre-merger location equilibrium. For that, we compute the FOCs w.r.t. m and q on the corresponding profits. Their system will yield equilibrium candidate locations, which we will afterwards check against the SOCs.

The FOCs are: $\left\{\begin{array}{l}\frac{\partial}{\partial m}\Pi_{1,2,3}=\frac{3}{16}a-\frac{9}{32}m-\frac{3}{16}q-\frac{9}{8}am-\frac{15}{8}mq+\frac{75}{32}m^2+\frac{3}{4}q^2+\frac{3}{128}=0\\ \frac{\partial}{\partial q}\Pi_{4,5}=\frac{5}{16}a-\frac{9}{32}m+\frac{1}{16}q+\frac{1}{8}am-\frac{3}{2}aq+\frac{17}{8}mq-\frac{37}{32}m^2-\frac{5}{128}=0\end{array}\right.$

and the SOC write therefore: $\left\{\begin{array}{l}\frac{\partial^2}{\partial m^2}\Pi_{1,2,3}=\frac{75}{16}m-\frac{9}{8}a-\frac{15}{8}q-\frac{9}{32}\leq 0\\ \frac{\partial^2}{\partial q^2}\Pi_{4,5}=\frac{17}{8}m-\frac{3}{2}a+\frac{1}{16}\leq 0\end{array}\right.$

As before, the system of FOCs is too complex to allow general solutions, so, as before, we are going to identify particular solutions, corresponding to the same set of values of the demand parameter a that have been retained before[28]. To identify the solutions, the Maple application of the ScientificWorkplace kit is employed, through the Solve then Numeric commands in the Compute main menu.

For $\underline{a=1.5}$, $\left[\begin{array}{l}\frac{3}{16}a-\frac{9}{32}m-\frac{3}{16}q-\frac{9}{8}am-\frac{15}{8}mq+\frac{75}{32}m^2+\frac{3}{4}q^2+\frac{3}{128}=0\\ \frac{5}{16}a-\frac{9}{32}m+\frac{1}{16}q+\frac{1}{8}am-\frac{3}{2}aq+\frac{17}{8}mq-\frac{37}{32}m^2-\frac{5}{128}=0\end{array}\right]_{a=1.5}$

$$=\left[\begin{array}{c}-\frac{2461}{1250}m-\frac{3}{16}q-\frac{15}{8}mq+\frac{75}{32}m^2+\frac{3}{4}q^2+\frac{30\,469}{100\,000}=0\\ -\frac{3}{32}m-\frac{35}{16}q+\frac{17}{8}mq-\frac{37}{32}m^2+\frac{42\,969}{100\,000}=0\end{array}\right],$$

[28] With still three firms on the market, the same conditions applies in order to guarantee positive quantities in equilibrium at every market point: $a\geq 1.5$.

Solution is: $\left\{ \begin{array}{c} [m = 1.3458, q = 2.6633], [m = 1.7281, q = 2.1454], \\ [m = 0.14818, q = 0.20848], \left[m = 0.59046, q = -3.0865 \times 10^{-2}\right] \end{array} \right\}$

where the solution satisfying the SOC is $m^* = 0.14818, q^* = 0.20848$, because:

$\left[\frac{75}{16}m - \frac{9}{8}a - \frac{15}{8}q - \frac{9}{32}\right]_{m^*=0.14818, q^*=0.20848} = 2.2444 \times 10^{-2} - \frac{9}{8}a < 0$

and $\left[\frac{17}{8}m - \frac{3}{2}a + \frac{1}{16}\right]_{m^*=0.14818, q^*=0.20848} = 0.37738 - \frac{3}{2}a < 0$ for $a = 1.5$

Moreover, the condition $q^* < \frac{m^*+1/2}{2}$ holds: $0.20848 < \frac{0.14818+0.5}{2} = 0.32409$

- for $\underline{a = 2}$: $\left[\begin{array}{c} \frac{3}{16}a - \frac{9}{32}m - \frac{3}{16}q - \frac{9}{8}am - \frac{15}{8}mq + \frac{75}{32}m^2 + \frac{3}{4}q^2 + \frac{3}{128} = 0 \\ \frac{5}{16}a - \frac{9}{32}m + \frac{1}{16}q + \frac{1}{8}am - \frac{3}{2}aq + \frac{17}{8}mq - \frac{37}{32}m^2 - \frac{5}{128} = 0 \end{array} \right]_{a=2}$

$= \left[\begin{array}{c} -\frac{81}{32}m - \frac{3}{16}q - \frac{15}{8}mq + \frac{75}{32}m^2 + \frac{3}{4}q^2 + \frac{51}{128} = 0 \\ -\frac{1}{32}m - \frac{47}{16}q + \frac{17}{8}mq - \frac{37}{32}m^2 + \frac{75}{128} = 0 \end{array} \right],$

Solution is: $\left\{ \begin{array}{c} [m = 1.8609, q = 3.4184], [m = 2.2105, q = 2.9168], \\ [m = 0.15261, q = 0.21209], \left[m = 0.7698, q = -9.4732 \times 10^{-2}\right] \end{array} \right\}$

From which the equilibrium locations are $m^* = 0.15261, q^* = 0.21209$

because $\left[\frac{75}{16}m - \frac{9}{8}a - \frac{15}{8}q - \frac{9}{32}\right]_{m^*=0.15261, q^*=0.21209} = 3.6441 \times 10^{-2} - \frac{9}{8}a < 0$ for $a = 2$

and $\left[\frac{17}{8}m - \frac{3}{2}a + \frac{1}{16}\right]_{m^*=0.15261, q^*=0.21209} = 0.38680 - \frac{3}{2}a$

in addition to $q^* < \frac{m^*+1/2}{2} \Leftrightarrow 0.21209 < \frac{0.15261+0.5}{2} = 0.32631$

- for $\underline{a = 2.5}$: $\left[\begin{array}{c} \frac{3}{16}a - \frac{9}{32}m - \frac{3}{16}q - \frac{9}{8}am - \frac{15}{8}mq + \frac{75}{32}m^2 + \frac{3}{4}q^2 + \frac{3}{128} = 0 \\ \frac{5}{16}a - \frac{9}{32}m + \frac{1}{16}q + \frac{1}{8}am - \frac{3}{2}aq + \frac{17}{8}mq - \frac{37}{32}m^2 - \frac{5}{128} = 0 \end{array} \right]_{a=5/2}$

$= \left[\begin{array}{c} -\frac{99}{32}m - \frac{3}{16}q - \frac{15}{8}mq + \frac{75}{32}m^2 + \frac{3}{4}q^2 + \frac{63}{128} = 0 \\ \frac{1}{32}m - \frac{59}{16}q + \frac{17}{8}mq - \frac{37}{32}m^2 + \frac{95}{128} = 0 \end{array} \right],$

Solution is: $\left\{ \begin{array}{c} [m = 2.4034, q = 4.1287], [m = 0.15535, q = 0.21420], \\ [m = 0.94825, q = -0.16015], [m = 2.6681, q = 3.736] \end{array} \right\}$

The equilibrium locations are by the same token: $m^* = 0.15535, q^* = 0.2142$

- for $\underline{a = 3}$: $\left[\begin{array}{c} \frac{3}{16}a - \frac{9}{32}m - \frac{3}{16}q - \frac{9}{8}am - \frac{15}{8}mq + \frac{75}{32}m^2 + \frac{3}{4}q^2 + \frac{3}{128} = 0 \\ \frac{5}{16}a - \frac{9}{32}m + \frac{1}{16}q + \frac{1}{8}am - \frac{3}{2}aq + \frac{17}{8}mq - \frac{37}{32}m^2 - \frac{5}{128} = 0 \end{array} \right]_{a=3}$

$= \left[\begin{array}{c} -\frac{117}{32}m - \frac{3}{16}q - \frac{15}{8}mq + \frac{75}{32}m^2 + \frac{3}{4}q^2 + \frac{75}{128} = 0 \\ \frac{3}{32}m - \frac{71}{16}q + \frac{17}{8}mq - \frac{37}{32}m^2 + \frac{115}{128} = 0 \end{array} \right],$

$$\text{Solution is: } \left\{ \begin{array}{c} [m = 1.1263, q = -0.22637], [m = 0.15720, q = 0.21557], \\ \left[m = 3.0364 - 5.1541 \times 10^{-2} i, q = 4.6979 + 7.8154 \times 10^{-2} i\right], \\ \left[m = 3.0364 + 5.1541 \times 10^{-2} i, q = 4.6979 - 7.8154 \times 10^{-2} i\right] \end{array} \right\}$$

thus the equilibrium are, by the same token: $m^* = 0.15720, q^* = 0.21557$

- for $\underline{a = 3.5}$: $\left[\begin{array}{l} \frac{3}{16}a - \frac{9}{32}m - \frac{3}{16}q - \frac{9}{8}am - \frac{15}{8}mq + \frac{75}{32}m^2 + \frac{3}{4}q^2 + \frac{3}{128} = 0 \\ \frac{5}{16}a - \frac{9}{32}m + \frac{1}{16}q + \frac{1}{8}am - \frac{3}{2}aq + \frac{17}{8}mq - \frac{37}{32}m^2 - \frac{5}{128} = 0 \end{array} \right]_{a=7/2}$

$$= \left[\begin{array}{l} -\frac{135}{32}m - \frac{3}{16}q - \frac{15}{8}mq + \frac{75}{32}m^2 + \frac{3}{4}q^2 + \frac{87}{128} = 0 \\ \frac{5}{32}m - \frac{83}{16}q + \frac{17}{8}mq - \frac{37}{32}m^2 + \frac{135}{128} = 0 \end{array} \right],$$

$$\text{Solution is: } \left\{ \begin{array}{c} [m = 3.5374 - 0.17323i, q = 5.4639 + 0.26672i], \\ [m = 3.5374 + 0.17323i, q = 5.4639 - 0.26672i], \\ [m = 1.3041, q = -0.29305], [m = 0.15853, q = 0.21655] \end{array} \right\}$$

therefore the equilibrium locations are $m^* = 0.15853, q^* = 0.21655$

- for $\underline{a = 4}$: $\left[\begin{array}{l} \frac{3}{16}a - \frac{9}{32}m - \frac{3}{16}q - \frac{9}{8}am - \frac{15}{8}mq + \frac{75}{32}m^2 + \frac{3}{4}q^2 + \frac{3}{128} = 0 \\ \frac{5}{16}a - \frac{9}{32}m + \frac{1}{16}q + \frac{1}{8}am - \frac{3}{2}aq + \frac{17}{8}mq - \frac{37}{32}m^2 - \frac{5}{128} = 0 \end{array} \right]_{a=4}$

$$= \left[\begin{array}{l} -\frac{153}{32}m - \frac{3}{16}q - \frac{15}{8}mq + \frac{75}{32}m^2 + \frac{3}{4}q^2 + \frac{99}{128} = 0 \\ \frac{7}{32}m - \frac{95}{16}q + \frac{17}{8}mq - \frac{37}{32}m^2 + \frac{155}{128} = 0 \end{array} \right],$$

$$\text{Solution is: } \left\{ \begin{array}{c} [m = 1.4819, q = -0.36002], [m = 0.15953, q = 0.21727], \\ [m = 4.0387 - 0.25408i, q = 6.2302 + 0.39566i], \\ [m = 4.0387 + 0.25408i, q = 6.2302 - 0.39566i] \end{array} \right\}$$

from which the equilibrium locations are: $m^* = 0.15953, q^* = 0.21727$

- for $\underline{a = 4.5}$: $\left[\begin{array}{l} \frac{3}{16}a - \frac{9}{32}m - \frac{3}{16}q - \frac{9}{8}am - \frac{15}{8}mq + \frac{75}{32}m^2 + \frac{3}{4}q^2 + \frac{3}{128} = 0 \\ \frac{5}{16}a - \frac{9}{32}m + \frac{1}{16}q + \frac{1}{8}am - \frac{3}{2}aq + \frac{17}{8}mq - \frac{37}{32}m^2 - \frac{5}{128} = 0 \end{array} \right]_{a=9/2}$

$$= \left[\begin{array}{l} -\frac{171}{32}m - \frac{3}{16}q - \frac{15}{8}mq + \frac{75}{32}m^2 + \frac{3}{4}q^2 + \frac{111}{128} = 0 \\ \frac{9}{32}m - \frac{107}{16}q + \frac{17}{8}mq - \frac{37}{32}m^2 + \frac{175}{128} = 0 \end{array} \right],$$

$$\text{Solution is: } \left\{ \begin{array}{c} [m = 0.16032, q = 0.21783], [m = 4.5401 - 0.32606i, q = 6.9966 + 0.5122i], \\ [m = 4.5401 + 0.32606i, q = 6.9966 - 0.5122i], [m = 1.6595, q = -0.42719] \end{array} \right\}$$

therefore the equilibrium locations are: $m^* = 0.16032, q^* = 0.21783$

- for $\underline{a = 5}$: $\left[\begin{array}{l} \frac{3}{16}a - \frac{9}{32}m - \frac{3}{16}q - \frac{9}{8}am - \frac{15}{8}mq + \frac{75}{32}m^2 + \frac{3}{4}q^2 + \frac{3}{128} = 0 \\ \frac{5}{16}a - \frac{9}{32}m + \frac{1}{16}q + \frac{1}{8}am - \frac{3}{2}aq + \frac{17}{8}mq - \frac{37}{32}m^2 - \frac{5}{128} = 0 \end{array} \right]_{a=5}$

$$= \left[\begin{array}{c} -\frac{189}{32}m - \frac{3}{16}q - \frac{15}{8}mq + \frac{75}{32}m^2 + \frac{3}{4}q^2 + \frac{123}{128} = 0 \\ \frac{11}{32}m - \frac{119}{16}q + \frac{17}{8}mq - \frac{37}{32}m^2 + \frac{195}{128} = 0 \end{array} \right],$$

$$\text{Solution is: } \left\{ \begin{array}{c} [m = 5.041\,6 - 0.394\,07i, q = 7.763\,1 + 0.623\,34i], \\ [m = 5.041\,6 + 0.394\,07i, q = 7.763\,1 - 0.623\,34i], \\ [m = 0.160\,95, q = 0.218\,28], [m = 1.837\,1, q = -0.494\,49] \end{array} \right\}$$

thus the equilibrium solutions are: $m^* = 0.160\,95, q^* = 0.218\,28$

Evaluating the profit functions for these values of the demand parameter and the corresponding equilibrium locations we obtain the following in terms of pre-merger total profits for the three-store firms and the single-store one:

a, m^*, q^*	$\Pi_{1,2,3}$	Π_6	$\Pi_{1,2,3} + \Pi_6$
$a = 1.5, m = 0.14818, q = 0.20848$	0.167 77	$7.116\,4 \times 10^{-2}$	0.238 93
$a = 2, m = 0.152615, q = 0.212092$	0.285 12	0.147 50	0.432 62
$a = 2.5, m = 0.15535, q = 0.2142$	0.433 63	0.254 22	0.687 85
$a = 3, m = 0.1572, q = 0.21557$	0.613 40	0.392 24	1.005 6
$a = 3.5, m = 0.15853, q = 0.21655$	0.824 42	0.561 53	1.386 0
$a = 4, m = 0.15953, q = 0.21727$	1.066 7	0.762 09	1.828 8
$a = 4.5, m = 0.16032, q = 0.21783$	1.340 2	0.993 92	2.334 1
$a = 5, m = 0.16095, q = 0.21828$	1.645	1.257	2.902

Post-merger equilibrium

Following the merger between the three-store firm and the single-store one, the resulting location equilibrium will be established between the two-store outsider and the four-store merged entity.

This pattern has already been worked out explicitly by Pal and Sarkar (2002), as an example for their general method of identifying location equilibria on the linear market in case of multi-plant Cournot competition. Basically, the two-store outsider will take up its monopoly locations, 1/4 and 3/4, whereas the four plants of the merged entity will locate each within one of the four interval thus created on the segment. Following the proof in Pal and Sarkar (2002), their respective locations are denoted $\frac{d}{2}, \frac{1-d}{2}, \frac{1+d}{2}, \frac{2-d}{2}$, where $d = a - \sqrt{a^2 - \frac{a}{2} + \frac{1}{8}}$. Given that the merged entity's profit writes

$$\Pi_{1,2,3+6} = 2\left(\begin{array}{c}\int_0^{\frac{d}{2}}\left(\frac{a-2(\frac{d}{2}-x)+(\frac{1}{4}-x)}{3}\right)^2 dx + \int_{\frac{d}{2}}^{\frac{1}{4}}\left(\frac{a-2(x-\frac{d}{2})+(\frac{1}{4}-x)}{3}\right)^2 dx \\ + \int_{\frac{1}{4}}^{\frac{1-d}{2}}\left(\frac{a-2(\frac{1-d}{2}-x)+(x-\frac{1}{4})}{3}\right)^2 dx + \int_{\frac{1-d}{2}}^{\frac{1}{2}}\left(\frac{a-2(x-\frac{1-d}{2})+(x-\frac{1}{4})}{3}\right)^2 dx\end{array}\right)$$

evaluating this expression for $d = a - \sqrt{a^2 - \frac{a}{2} + \frac{1}{8}}$ yields

$\Pi_{1,2,3+6} = \frac{4}{9}a^2 - \frac{1}{12}a - \frac{16}{27}a^3 + \frac{1}{54}\sqrt{a^2 - \frac{1}{2}a + \frac{1}{8}} - \frac{5}{27}a\sqrt{a^2 - \frac{1}{2}a + \frac{1}{8}} + \frac{16}{27}a^2\sqrt{a^2 - \frac{1}{2}a + \frac{1}{8}} + \frac{1}{144}$

The next step is to evaluate this expressions for the values retained for the demand parameter, so as to find the values of the post-merger joint profit of the insiders:

a	1.5	2	2.5	3	3.5	4	4.5	5
$\Pi_{1,2,3+6}$	0.25113	0.44559	0.69559	1.0012	1.3623	1.7789	2.2512	2.7789

Conclusion: a straight comparison between the pre- and post-merger joint profit of insiders reveals that, *as for the example constructed in the body of Chapter 3, the merger is only profitable for the lowest values for the demand parameter* $a \in [1.5, 3]$*, and becomes unprofitable when demand grows larger.*

Post-merger partial divisionalization equilibrium

In what follows, we consider partial divisionalization on behalf of the merged entity, meaning spinning off into two two-store independent divisions. We will thus be able to compare the profitability of this subsequent divisionalization with that of the 'simple' merger, as well as w.r.t. the initial joint profit of the insiders.

To compute the profitability of this partial divisionalization, we need first the location equilibrium determined after this spin-off. Basically, three two-firm independent firms compete on the segment now, so following (again) the results obtained by Pal and Sarkar (2002), regardless of the number of firms on the linear city, as long as they all operate the same number of stores, the multi-plant monopoly locations are chosen in equilibrium. In short, each of the three firms will locate one outlet at 1/4, and the second at 3/4.

The profit for one firm writes therefore:

$\Pi_{1,2} = 2\left(\int_0^{1/4}\left(\frac{a-3(\frac{1}{4}-x)+2(\frac{1}{4}-x)}{4}\right)^2 dx + \int_{1/4}^{1/2}\left(\frac{a-3(x-\frac{1}{4})+2(x-\frac{1}{4})}{4}\right)^2 dx\right) = \frac{1}{16}a^2 - \frac{1}{64}a + \frac{1}{768}$

The joint profit after divisionalization (i.e. of the two-division group) amounts therefore to:

$\Pi_{1,2} + \Pi_{3,6} = 2\left(\frac{1}{16}a^2 - \frac{1}{64}a + \frac{1}{768}\right) = \frac{1}{8}a^2 - \frac{1}{32}a + \frac{1}{384}$

which, evaluated for the values of the demand parameters used so far, yields:

a	1.5	2	2.5	3	3.5	4	4.5	5
$\Pi_{1,2} + \Pi_{3,6}$	0.23698	0.4401	0.70573	1.0339	1.4245	1.8776	2. 3932	2.9714

To better seize the profitability comparison, we give next a summarizing table with the joint profit made by the insiders before merger, afterwards, and after the subsequent partial divisionalization:

a	$\Pi_{1,2,3} + \Pi_6$	$\Pi_{1,2,3+6}$	$\Pi_{1,2} + \Pi_{3,6}$
1.5	0.238 93	0.25113	0.23698
2	0.432 62	0.44559	0.4401
2.5	0.687 85	0.69559	0.70573
3	1.005 6	1.0012	1.0339
3.5	1.386 0	1.3623	1.4245
4	1.828 8	1.7789	1.8776
4.5	2.334 1	2.2512	2.3932
5	2.902	2.7789	2.9714

Conclusion: for the lowest values of the demand parameter, $a \in \{1.5, 2\}$, the partial divisionalization is not more profitable than the complete integration of affiliates, although it can ensure a higher profit w.r.t. the pre-merger situation. Notwithstanding this difference with the example discussed in the body of Chapter 3, for all the other values of the demand parameter, again, **we obtain that the partial divisionalization following merger increases more the profits than the simple integration does.** In other words, *this example shows that the complementarity between merger and partial divisionalization within a two-stage business strategy to increase profits is robust to a change in the number of plants owned by the remaining market rival.*

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Résumé

Cette thèse contribue à l'étude théorique des concentrations horizontales, du point de vue positif comme normatif. La première partie analyse les motivations et les conséquences des fusions horizontales dans un cadre spatial. Le premier chapitre propose une revue de la littérature théorique consacrée à cette problématique. Le deuxième chapitre étudie l'impact du choix optimal de localisation post-fusion sur la profitabilité de la concentration. Le troisième chapitre prolonge cette analyse en considérant la possibilité pour la concentration d'être suivie de la formation de divisions indépendantes, ce qui peut s'avérer encore plus profitable grâce à une relocalisation optimale. La deuxième partie de la thèse se concentre sur les stratégies des autorités de la concurrence lorsqu'il existe des asymétries d'information sur les caractéristiques des fusions proposées. On analyse alors le profile optimal du contrôle des concentrations compte tenu de l'interaction stratégique entre les autorités et les firmes fusionnantes. Le quatrième chapitre dresse le bilan des conséquences de cette interaction stratégique pour la théorie et la pratique du contrôle des fusions. Le cinquième chapitre étudie l'impact des mesures correctives sur la prise en compte des gains d'efficacité pour l'évaluation des concentrations et conclut sur l'opportunité de combiner les deux procédés quand l'information est asymétrique. Le dernier chapitre propose un mécanisme de révélation basé sur les mesures correctives pour extraire l'information privée des firmes fusionnantes lors du contrôle des concentrations.

Mots-clé : fusions d'entreprises, oligopoles, industrie - localisation, concurrence – politique publique

Abstract

This dissertation aims to provide further theoretical insight, both positive and normative, for the analysis of horizontal mergers. The first part will examine the individual private incentives to merge and some of the ensuing welfare consequences in a spatial framework. The first chapter will review the theoretical literature dealing with horizontal market concentration in spatial models. The second chapter focuses on the impact of optimal post-merger location choice for merger profitability. Chapter three examines instead in a spatial setting the profitability link between acquisition and de-acquisition, given the possibility to optimally locate ex-post. The second part of the dissertation analyses the strategic interaction between the merging firms and the competition authorities, in light of their respective individual incentives and given the information asymmetry on the merger characteristics, so as to draw conclusions and make recommendations for the optimal profile of merger policy. Chapter four takes stock on the challenges raised by this strategic interaction for both the theory and practice of merger control. Chapter five examines the impact of merger remedies for the merger efficiency defence, and concludes on the opportunity to apply them both within an optimal merger control. The last chapter sheds light on the design of divestiture contracts with asymmetric information, and proposes a revelation mechanism based on merger remedies to optimally screen notified mergers.

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